JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXIII NO. 10 | SAN FRANCISCO, SEPTEMBER 4, 1909 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS

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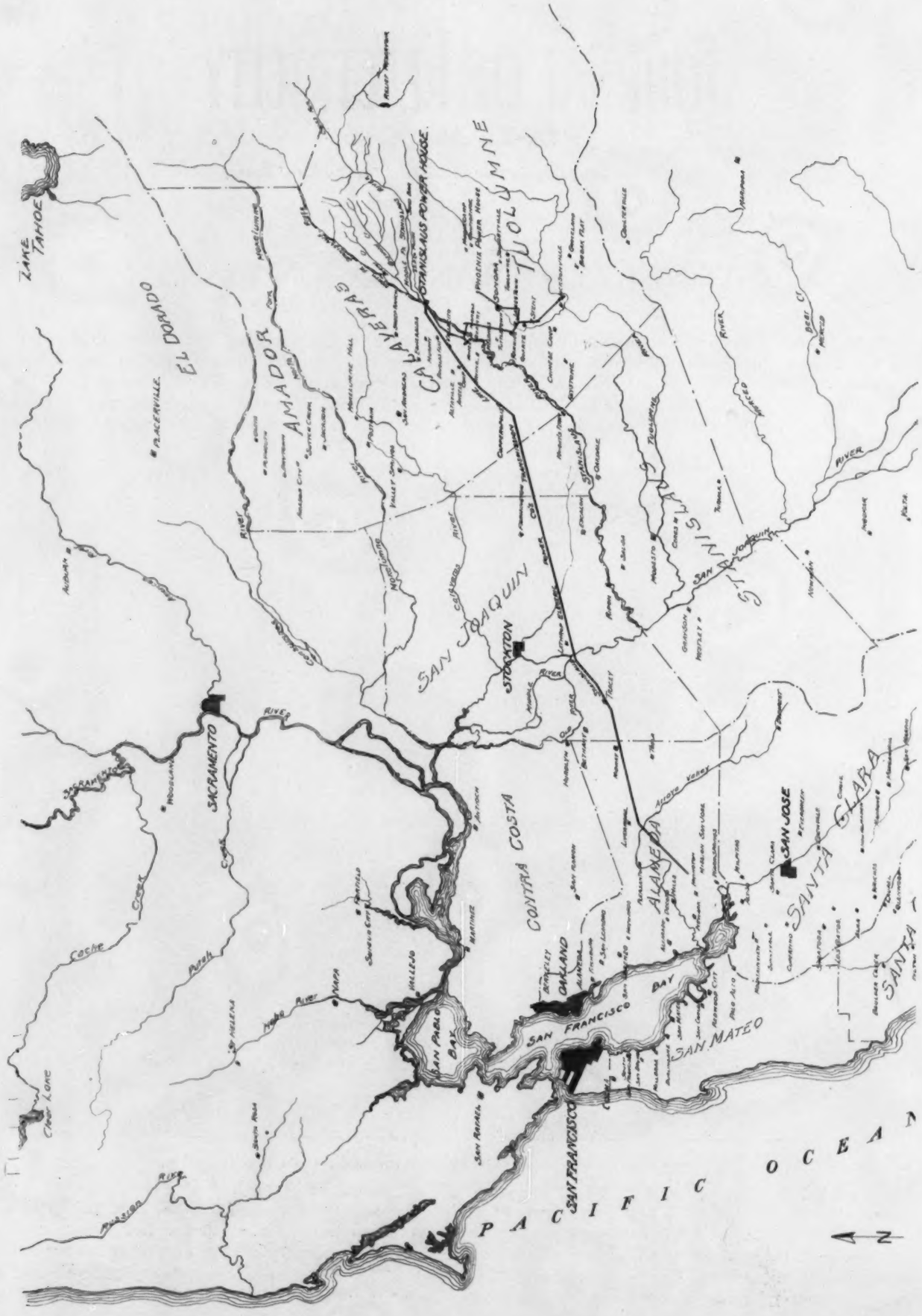
VOLUME XXIII. SAN FRANCISCO, SEPTEMBER 4, 1909 NUMBER 10

STANISLAUS TRANSMISSION LINE.

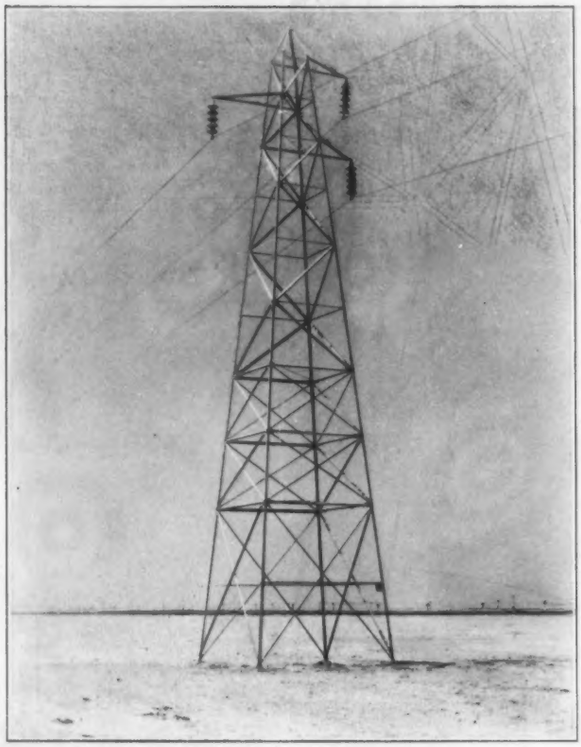
The high tension transmission line of the Stanislaus power development climbs out of the precipitous canyon of the Stanislaus river above the power house in Tuolumne County, and extends through the foothills of the Sierra Nevadas, crossing the Mother Lode just south of Angels Camp in Calaveras County, and then enters the level floor of the San Joaquin Valley, passing by the towns of Stockton, Tracy and Livermore to its present terminal in Alameda County near Mission San Jose, a distance of 100 miles; from which point it is now being extended across the southern arm of San Francisco Bay to San Francisco, a distance of 35 miles.

The current is to be transmitted at 100,000 volts; three phase, sixty cycle. Steel towers are used throughout and are of the square leg type diagonally braced down to the ground. The lowest cross arm is 50 feet above the ground and the total height of the tower is 67 feet. Towers of less heights are used in mountainous country or where short spans are necessary. The towers are spaced about 850 feet apart on the average, which gives a minimum clearance of the lowest wire from the ground of over 25 feet. Two

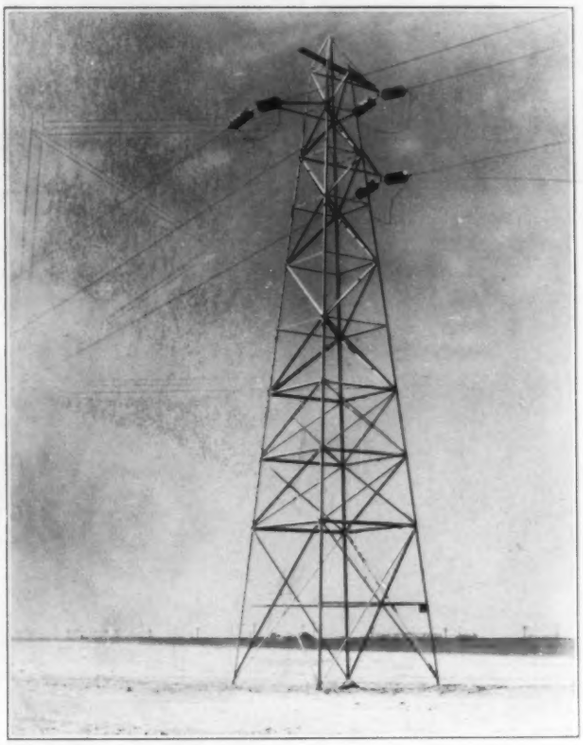
Stanislaus Transmission Line Crossing the San Joaquin River.



Map of Transmission Line of Stanislaus Electric Power Company, Extensions to Be Made to San Francisco and San Jose.



Transmission Tower with Suspended Insulators

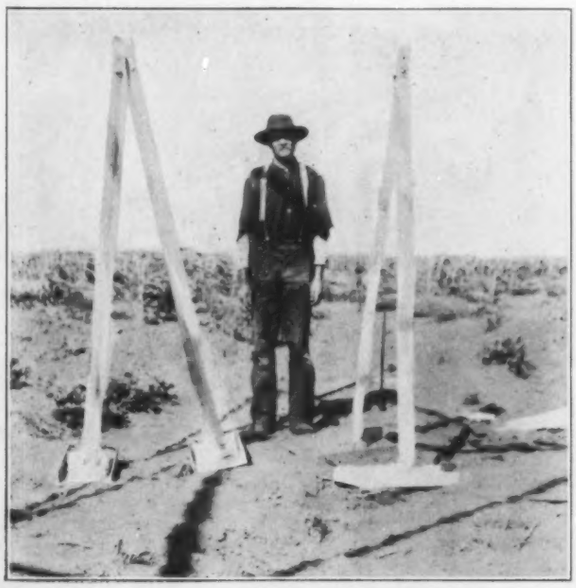


Transmission Tower with Strain Insulators.

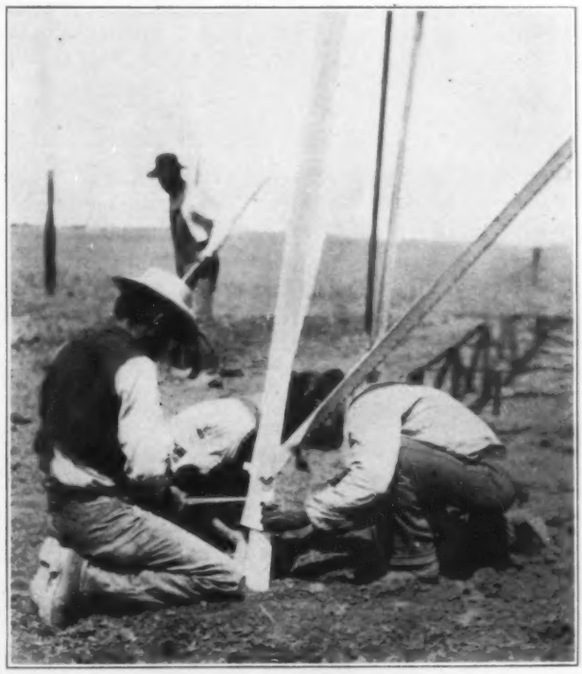
types of towers are being used—a single circuit constructed to carry three wires and a double circuit tower constructed with six cross arms capable of carrying six wires or two independent three phase circuits.

This design was finally created by first figuring the various members theoretically and then subjecting the assembled tower to physical tests, similar to those which it will meet in service, and the applied loads were increased until the weaker members failed. These were then strengthened and a new test applied to determine other weak members. In this way a tower was finally designed along the line of the famous "One Horse-shay." All the towers were furnished by the Aermotor Company of Chicago.

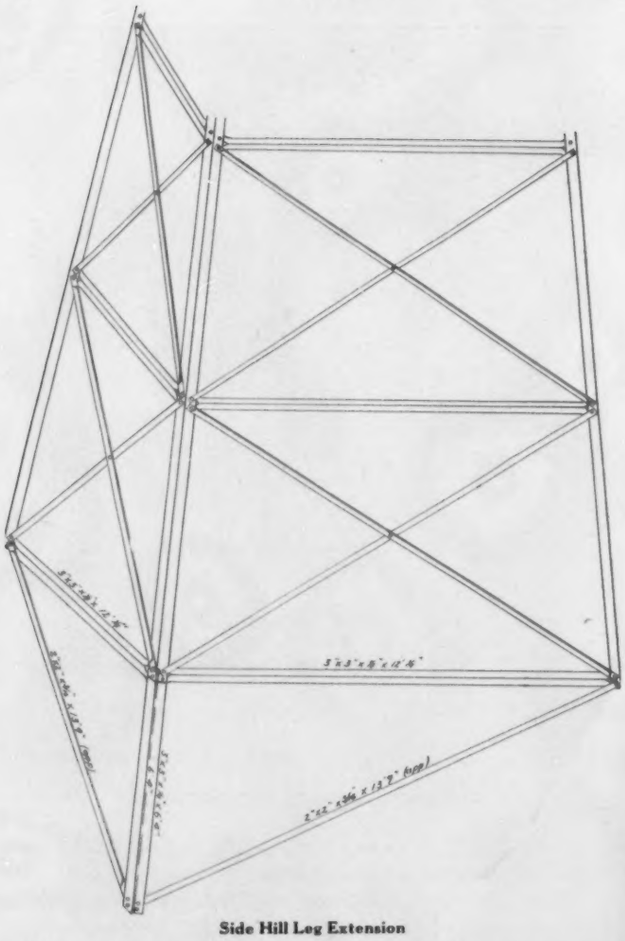
The anchor consists of a bifurcated leg with a plate on each branch as shown in accompanying photograph, thus making eight plates under each tower. This type was first used in the South to reduce the cost of concrete foundations. After being erected and tested it was found to have a better anchorage and bearing value than the concrete and practical experience indicates it has an indefinite life. The



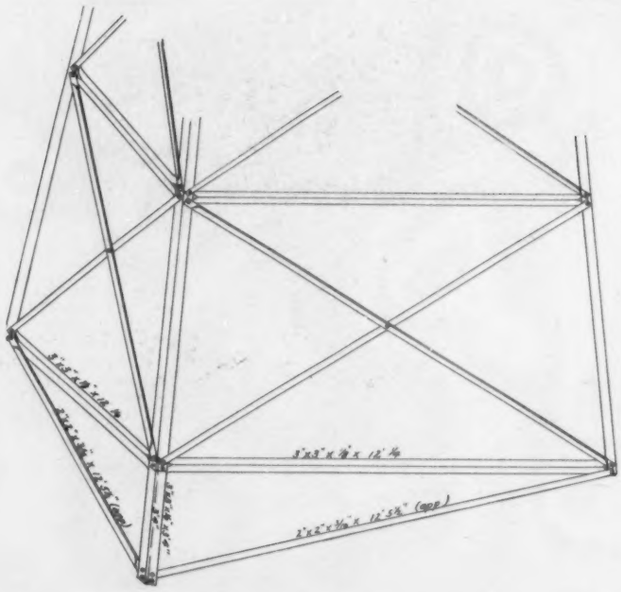
Tower Anchor.



Bolting Tower Leg to Anchor.



Side Hill Leg Extension



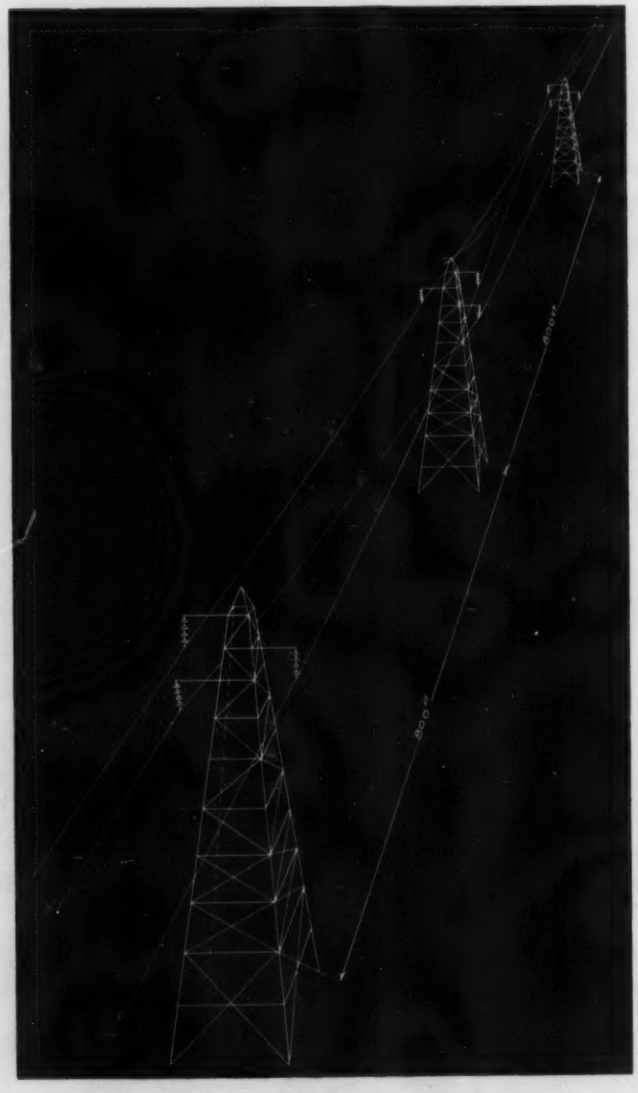
Side Hill Leg Extension

bifurcated leg gives a much larger cone of rupture than one with the same area of metal combined into one plate, and pound for pound provides a foundation several times more effective than any other foundation heretofore used. This type of foundation was used in dry hard soil but where soft and swampy land was crossed piling with reinforced concrete caps or reinforced concrete cylinders have been adopted. On side hills leg extensions were used as shown in accompanying illustration.

The line already completed, as far as Mission San Jose, and which has been delivering energy continuously since October, 1908, is of single circuit towers and the line from Mission San Jose, under active construction at the present time, to San Francisco, will be of double circuit towers, as will the second line, also under active construction, from the power house to Mission San Jose, which will give the company three separate circuits capable of delivering 20,000 kilowatts each, or a total of 80,000 h. p. at Mission San Jose and two separate circuits from there to San Francisco, each also having a capacity of 20,000 kilowatts.

The great care which has been used in the erection of these lines, the high factor of safety provided in all parts, together with use of the best grade of materials and the most modern design, insures a constant and uninterrupted delivery to the consumers of this vast amount of power and no expense has been spared to obtain this end.

As soon as the line to Mission San Jose was completed in October of last year, the delivery of power



Transmission Line Transposition.

was commenced to the sub-station of the Pacific Gas & Electric Company at that point, and during the period of eleven months since not a single interruption has occurred because of trouble with the towers. When it is considered that the past winter was extraordinarily severe and that many transmission lines in this vicinity suffered serious damage and interruption of service, due to high winds, floods, etc., it is noteworthy that the Stanislaus transmission line maintained uninterrupted service. For its entire distance the line is practically on a tangent, thus obviating the danger incurred by undue stresses at angle points. Complete transpositions have been made at intervals of ten miles. The conductors are 00 six strand hemp center copper cable and the insulators are of the suspension type, five separate elements making up each insulator. These insulators being made of separate units an opportunity is thus afforded of increasing the insulation by adding extra elements at points when atmospheric or other unfavorable conditions make same desirable.

The insulators were furnished by the Locke Insulator Manufacturing Company of Victor, New York.

Insulators developed for this line through the joint efforts of the Sanderson & Porter Co. of New York and the pottery engineers are of a radically different type than anything heretofore installed for this purpose. The reason for using the suspended type rather than the old pin type was largely of an electrical nature, since a pin type insulator for anything like 110,000 volts becomes of such great size that its cost is almost prohibitive,, purely from the standpoint of pottery difficulties. However, it is found that mechanically the insulators have also very desirable characteristics, in that the heavy conductors are permitted to have free movement in any direction, and there is much less liability of the wrecking of towers when any unusual strain comes upon the line.

The first suspension insulators were used by the wireless telegraph companies about six years ago to support the high tension aerial wires used in such service. These insulators as first developed were used in both horizontal and vertical positions and in many cases worked under excessively heavy strains, both mechanically and electrically.

The early suspension insulators were made of one piece of electrical porcelain with a malleable iron cap cemented at the top and a malleable iron hook or eyebolt cemented on the interior, such shells ranging from five-eighths to three-quarters of an inch in thickness and from 10 to 14 inches in diameter. For 100,000 volts four or five such units were suspended,one directly above the other, and at a distance of from eight to ten inches between units. So far as rain tests upon a combination of this sort is concerned results were fairly satisfactory, if compared with similar tests upon pin type insulators for 60,000 or 70,000 volts, but with the adoption of the suspension type insulator a new condition was found to arise which had not been so apparent upon any of the pin type insulators. This condition came about through the unequal potential distribution over the length of the insulator composed of four or five units, the unit adjacent to the conductor being found to carry more than its due proportion of the voltage drop. Normally this is of little interest but when any unusual strain comes upon a transmission line, either from lightning surge or from switching strain, the potential piles up around the unit adjacent to the conductor and there is great liability of its failing by direct puncture. The piling up is analogous to the choking effect of the end coils of the high tension transformer, and as noted probably occurs only when a steep wave front generated by lightning or switching strains approaches the insulator. The failure of the bottom unit caused considerable anxiety on the part of the designing engineers, since it is hardly feasible to produce electrical porcelain of good mechanical and electrical characteristics, which will stand

Insulator Arcing at 205,000 volts in Rain Test

a commercial electrical test in excess of 75,000 volts over one-half to three-quarters of an inch in thickness. This is not to say that porcelain of such a thickness cannot be made for higher test, but it has been found from long experience that it is wiser not to attempt to make material so highly vitrified as to stand a test in excess of that value.

From the foregoing it is obvious that there are two ways of preventing the puncture of the unit adjacent to the conductor. One is to make that unit of comparatively small diameter, another is to increase its capacity so that the potential drop through it may be low, but the logical way is to make it of sufficient strength to withstand indefinitely a complete flash over voltage, which would, of course, forever forbid its puncture.

Accordingly the insulators for this line were made

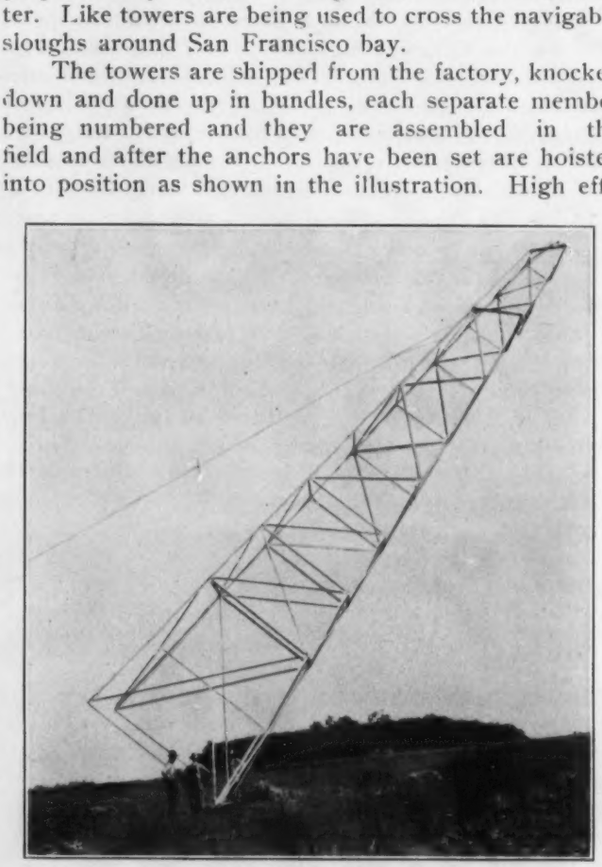
up of units, each unit consisting of two porcelain shells of approximately ½-inch in thickness, and each shell tested to its full flash over value, ranging from 55,000 to 75,000 volts. After test the shells of this unit are cemented together, a malleable cap cemented to the outside of the outermost shell and a U bolt inserted in the inner shell. Neat Portland cement was used to attach these shells together and when such cement had become thoroughly dry a flashover test of approximately 105,000 volts was applied for several minutes. As evidence of the great strength of such units from the electrical standpoint, it is interesting to know that if immersed in oil and tested to break down failure occurs between 175,000 and 190,000 volts, which is ample margin over the flashover value of 105,000 volts.

The operating engineer is, of course, chiefly interested in what such insulators will do under the worst possible conditions of rain. To get the most out of a unit of the type shown it is highly desirable that the disc be as flat as possible, but, because of the fact that it flashed over any arc following the flash would tend to be confined under the shells, it was deemed desirable to make the individual shells at an angle of approximately 45 degrees, thus making an inclosed air space under them, which on flashover caused the entrapped air to suddenly expand with the heat and so blow any arc away from the porcelain, thus preserving the porcelain from cracking and allowing the continuous operation of the line. When suspended one below the other the maximum striking distance between units of this type is approximately 4½ inches, and 4½ inches between needle points would represent a potential of practically 60,000 volts, and this is very close to the actual results secured experimentally in the high tension laboratory; thus four units would have a flash over when under a rain of 1 inch in five minutes at an angle of 45 degrees of approximately 240,000 volts. Each unit has a leakage distance of about 24 inches, so the four units so put up for 100,000 volts would have a total leakage distance of approximately 96 inches—a value entirely ample for insulation even under the worst conditions of weather.

The mechanical characteristics of suspension type insulator are interesting, and it has been found that the free movement of the conductor when thus suspended is of very material advantage. It is necessary, however, that a unit of very great strength be provided in order to avoid any difficulty when excessive mechanical loads are put upon the insulator, and not wishing to trust to the old fashioned simple cement joint as used on pin type insulators a special joint was devised for this purpose. The interior of both shells are recessed at the bottom and that the U bolt after it has been entered in the small hole springs out so as to entirely fill this recessed interior. All strains placed upon this unit come rather as compressional strains upon the porcelain than as strains in shear upon the cement and porcelain. It has been found that such units have an average ultimate strength of approximately 14,000 pounds—many units far exceeding this value. A commercial test of 5,000 pounds is put upon each unit before shipment from the factory.

On the first page the line is shown crossing the San Joaquin river, a navigable stream, where it was necessary to provide 90 ft. clearance between the lowest wire and high water, thus necessitating two towers 120 ft. in height set on concrete piers. The design of these towers is in all respects similar to the standard tower, additional panels being added at the base of proportionally increase strength and of the same batter. Like towers are being used to cross the navigable sloughs around San Francisco bay.

The towers are shipped from the factory, knocked down and done up in bundles, each separate member being numbered and they are assembled in the field and after the anchors have been set are hoisted into position as shown in the illustration. High effi-



Hoisting Tower Into Position.

ciency and speed is obtained in the assembly and erection of these towers. A gang of thirty-five men when trained to do the work will move through the country, living in a camp mounted on a wagon which travels with them, and these will set the foundation, assemble, erect and complete an average of five towers per day. This gang is followed by another gang similarly equipped and organized, who assemble and erect the insulators and string the cables. Such a gang will string 1¾ miles of three circuit line per day. Before these gangs take the field the material is hauled by wagon from the nearest railroad terminal and delivered at the tower site.

The lines will enter a large receiving station just outside the limit of the City of San Francisco where the current will be stepped down from 100,000 volts to 2300 volts for final distribution. The sub-station will be of reinforced concrete of a high grade construction throughout and there are now being manufactured by the General Electric Company seven 3300 k. w. transformers.

The Stanislaus transmission line, as well as the rest of the equipment of this power development, was constructed under the supervision of Sanderson & Porter, consulting engineers.

MODERN INCANDESCENT LAMPS AND IMPROVED LIGHTING.[1]

BY E. L. SHERWOOD.

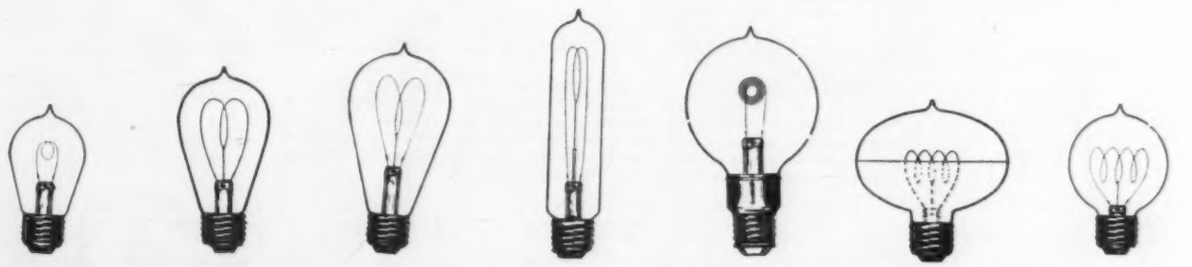
Illumination, or rather high efficiency in illumination, is becoming more and more an everyday problem. The recent discoveries and resultant improvements in filaments have made possible an efficiency that ranges as high as one watt per candlepower in modern incandescent lamps. Ideal from all other standpoints of consideration, the incandescent lamp, crowned with its newly acquired efficiency, may be said to reign almost supreme in the present lighting field. Certainly it has given a noticeable stimulus to electric lighting in general.

Within the past four years we have seen the beginning of a new epoch in the history of the lighting industry, brought about primarily by these wonderful improvements—the culmination of successful scientific investigations here and abroad to find a more efficient substitute for the old carbon filament.

TABLE I.

Type of Filament.	Watts per Candlepower.	Hours life to 80% candlepower at watts per Candle Given.	Candlepower per Kilowatt at efficiency to give 500 Hours Life to 80% Candlepower.
Carbon . . . . . (Bamboo untreated)	3.75	260	240
Carbon . . . . . (Bamboo treated)	3.10	260	290
Carbon . . . . . (Cellulose treated)	3.10	510	325
Gem	2.60	550	390
Tantalum	2.00	800	545
Tungsten	1.25	800	875

The publicity given these new achievements has brought to the attention of consumers the great need for more efficient illumination, hence we have had a remarkable reform in the application of lighting; the elimination of former wasteful methods, the advent of the illuminating engineer, scientific design of reflectors, the calculation of correct intensities evenly distributed, the study of the illuminant and its relation to colors for producing desired effects. Many central stations have employed men to specialize on this work, and have found results surprisingly beneficial to their service.



Sign Lamp 2 and 4 c. p. | Regular 4, 6, 8 and 10 c. p. | Regular 16 and 20 c. p. | Tubular Lamp 8, 10 and 16 c. p. | Stereopticon Lamp 32 and 50 c. p. | Reflector Lamp 14, 35 and 45 watts | Round Bulb Lamp 4, 8, 10 and 16 c. p.

Various Types of Carbon Filament Lamps.

The perfecting of the Gem (G. E. Metallized) or improved carbon filament, secured us a clear gain in efficiency of 20 per cent, without loss of life over carbon lamps. Further interesting and important discoveries made possible the tantalum and tungsten (metal filament) lamps with relative gains in efficiency of 30% and 60%, and the promise of still greater gains.

Much of the gain in efficiency with metallic filaments is due to the higher temperatures at which it is possible to operate them as compared with the carbon filament. In the comparison given below, the temperature of operation for carbon filament was taken from Houston's Electric Incandescent Lighting.

Type of Filament.	Watts per Candle.	Operating Temperature, Degrees Centigrade.
Carbon	4.5	1290
Carbon	4.	1310
Carbon	3.	1345
Tungsten ..	1.25	1930

Early carbon filaments were necessarily operated at a very low efficiency so as to secure a useful life approaching commercial demands. Some idea of the total improvement since that time may be gained from the comparisons given in Table I, showing the candlepower per kilowatt obtainable by rating each of the different filaments at a suitable efficiency to give 500 hours life to 80% candlepower.

Fig. 1 indicates graphically the great importance of even slight increases in lamp efficiency in reducing the cost of light production, economizing, as it were, the remaining energy available after considerable losses in generation and distribution.

The Gem Lamp and the Central Station.

It is now generally conceded that the old standard carbon lamp will shortly be supplanted entirely by the higher efficiency types. The 50 and 100 c. p. Gem filament lamps entirely replace carbon lamps of the same candlepower rating. The 40 c. p. or 100-w. Gem should displace 32 carbon lamps, the extra life alone, as shown by Table II, being sufficient to offset the small extra cost of the Gem lamp.

TABLE II.

Voltage Range.	Gem 100-watt.			Corresponding Life Values of Carbon 32 C. P.	
	w. p. c.	Mean Horiz. Candlepower.	Useful Life.	w. p. c	Useful Life.
Top or 1st voltage.	2.55	40	550	3.1	430
Middle or 2d "	2.7	36.7	777		
Bottom or 3d "	2.88	33.5	1130	3.57	900

As the bulb of the 100-w. Gem is somewhat larger than that of the old 32 c. p. carbon lamps, there is a

[1]Paper to be read at Annual Convention Northwest Electric Light & Power Association, Seattle, September 8, 1909.

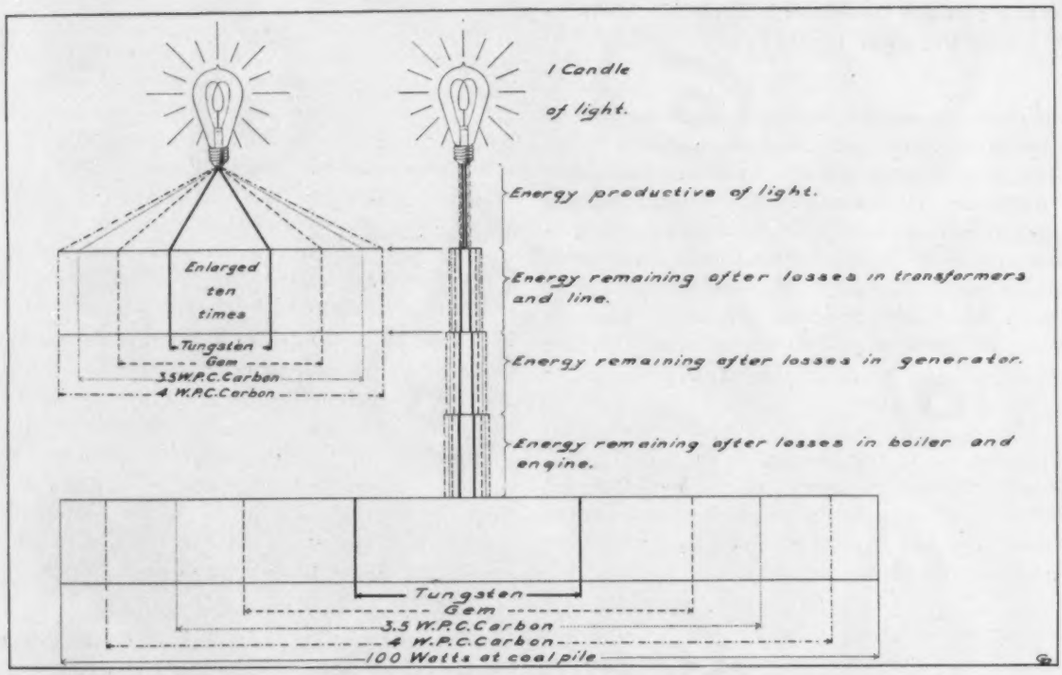


Fig. 1. Energy at Coal Pile Requisite for 1 candle of light from lamp, showing the important position of the lamp as a light producer, and bringing out in a striking manner the fact that a loss in lamp efficiency requires a proportional increase in generating equipment, indicated by the alarming growth of the pyramid base with lower efficiency lamps.

demand for a smaller Gem lamp, about the same candlepower, and this is met by the 80-watt Gem, which is made in the regular 32 c. p. bulb.

The Gem 40 and 50-watt styles furnished in the same bulb as the ordinary 16 c. p. carbon lamp, should shortly displace the old 12 and 16 c. p. sizes. The Edison Companies in New York, Boston, Chicago, Philadelphia, Brooklyn, and many other central stations are today using Gem lamps exclusively in place of carbon lamps of 16 c. p. and above. Table III gives the candlepower obtainable from 40 and 50-watt Gem lamps at the different voltage ratings, and shows the saving possible by replacing 3.5 w. p. c. carbon lamps with Gem lamps of nearest corresponding candlepower.

TABLE III.

	50 and 40 watt Gem.		3.5 w. p. c. carbon.		Saving obtained with Gem.		
Voltage.	M. H. C. P.	Total Watts.	M. H. C. P.	Total Watts	Watts per Lamp	Per Cent Saved	Per Cent Increase C. P.
50-w (Top	20	50	20	70	30	41	0
Lamp(Middle	18.3	48.5	16	56	7.5	13.4	12.5
(Bottom	16.7	47.3	16	56	8.7	15.5	4.2
40-w (Top	16	40	16	56	16	28.5	0
Lamp(Middle	14.4	38	12½	45.4	7.4	16.4	13.2
(Bottom	12.8	36	10	36	....	....	21

The Gem filament has a slight advantage in being less sensitive on fluctuating voltage, having a positive co-efficient of resistance (like metal filaments), as illustrated by the curve shown in Fig. 2. The light given by the Gem lamp is distinctly better in quality (whiter) than that of the ordinary carbon filament. When introducing the Gem lamp, it is important to adopt a suitable voltage range to give life equal to that obtained from carbon lamps now in service.

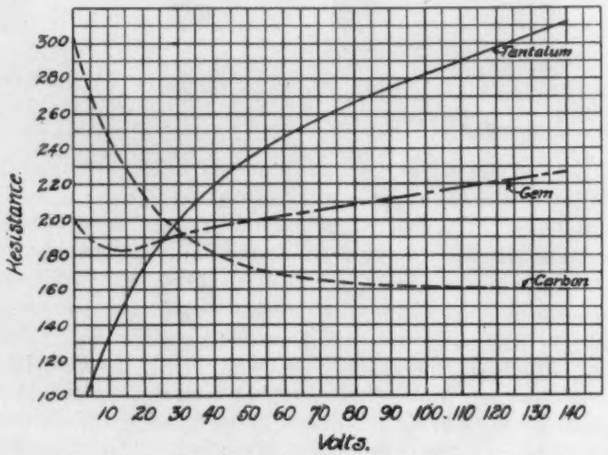


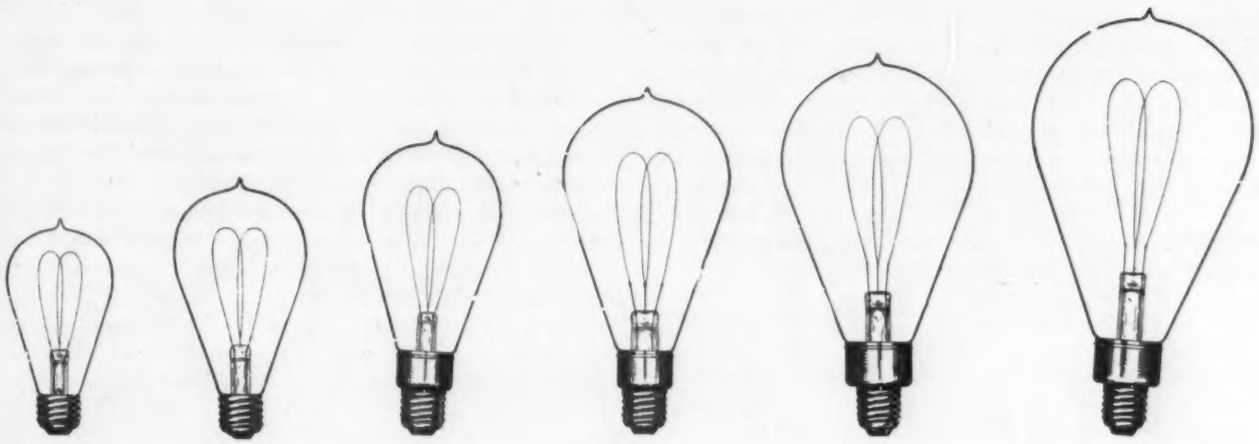
Fig. 2. Change of Resistance with Increase of Voltage.

The curves shown in Fig. 3 indicate the useful life of Gem and carbon filament lamps at various watts per candle ratings.

The Gem lamp is rated in total watts having three voltage markings, designated as first, second and third voltage. Table IV shows the efficiency of the Gem lamp at each voltage rating, and also the efficiency of a carbon lamp of corresponding life. Where 3.5 w. p. c. lamps are now used, Gem lamps should be introduced at bottom voltage.

TABLE IV.

Voltage Range.	Watts per Candle.	Efficiency of ordinary Carbon Lamp of nearest similar life.
Top or 1st voltage.....	2.55	3.1 w. p. c. 16 c. p.
Middle or 2d voltage....	2.7	3.3 w. p. c. 16 c. p.
Bottom or 3d voltage...	2.88	3.5 w. p. c. 16 c. p.



Various Sizes of Gem Lamps.

The particular advantage for central stations in the introduction of the Gem at 2.5 w. p. c. is that it enables them, without any reduction in rates, to give their customers 25% more light of a more brilliant quality, as compared with a carbon lamp using the same energy.

Where the carbon lamp in use at present is 3.5 w. p. c., without change in rates, central stations can give their customers a reduction in bills of over 15% for the same illumination of better quality. For this reason companies changing from flat to meter rate systems will find it beneficial at such a time to entirely abandon the ordinary carbon lamps, and substitute the small size Gems.

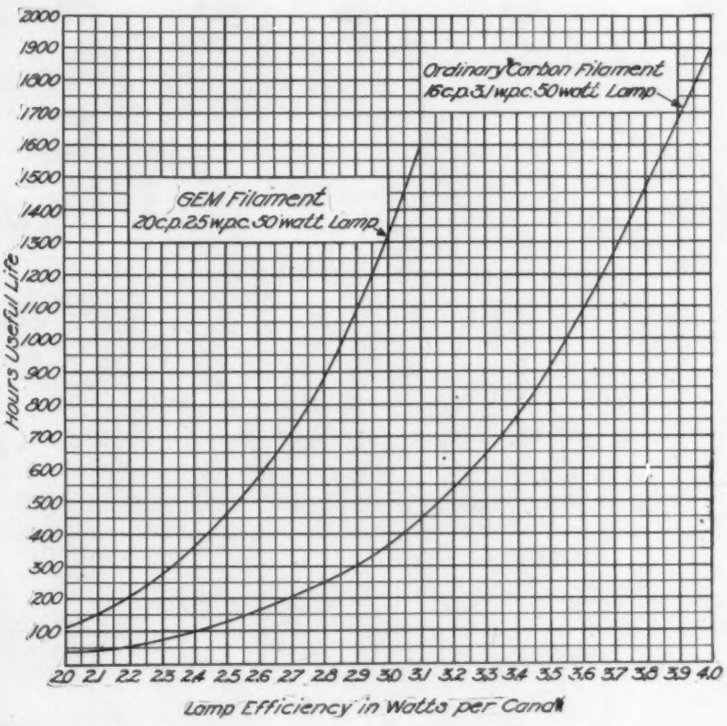


Fig. 3. Useful Life Curves of Gem and Carbon Filament Lamps.

There is only one possible objection to introducing these lamps—a small increased renewal cost on the kilowatt hour basis, due to the better efficiency of the Gem as compared with the carbon lamp. This slight increase in cost can be, and is being borne by many companies who are now furnishing Gem lamps to their customers on the same terms as carbon lamps. Gem

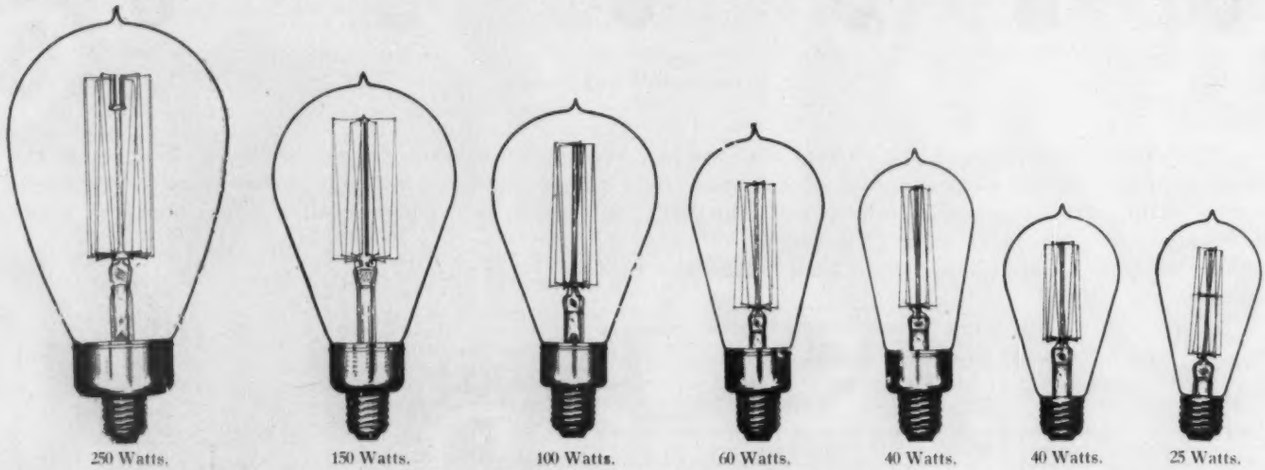
130 VOLTS AND BELOW.	Carbon Class. Includes all Carbon Filament Lamps.	Gem Class. Including all Gem Filament Lamps.	Tungsten Class. Includes all Tungsten Filament Lamps.
Type. Regular. Includes all pear shaped bulbs.	16 and 32 c. p. 50 and 100 c. p. changing to Gem.	40, 50, 80 and 100 w. 125, 187 and 250 w. changing to Tungsten.	25 and 40 small bulb. 40, 60, 100, 150 and 250 w.
Type. Irregular. Includes Round, Tubular, Reflector, Stereopticon, etc.	All carbon filament except meridian type.	Gem Meridian.	Tungsten. Meridian.
Type. Low Volt. Includes all large lamps below 20 volts.	Regular low volt changing to Tungsten types.		Regular pear shape and round bulb Tungsten.
Type. Candelabra and Decorative. Includes all Miniature lamps for standard lighting service.	Decorative low volt type changing to Tungsten types.		Decorative Tungsten low volt for series burning.
Type. Battery and Telephone. Includes all Miniature lamps for battery service.	Battery and Novelty lamps changing to Tungsten types.		Complete line of Tungsten Battery and Novelty lamps.
Type. Regular. Pear shaped bulbs only.	All sizes of street series changing to Tungsten Types.		Complete line of street series Tungstens of different candle-power and ampere ratings.
Style. LARGE. Includes all lamps fitted with standard size of base.			
Style. MINIATURE. Includes all lamps based with Miniature or Candlebra bases or with Miniature bulbs unbased.			
Style. STREET SERIES. Includes all lamps fitted with the large Edison base or other types of special Street Series Lamp Bases.			

Classification Showing Trend to Higher Efficiency Types of Lamps.

lamps made during the past year show increased useful life, much greater than that claimed in published data, and the percentage of early breakage has been materially reduced in the more recently manufactured lamps, so that at present there is little in practical results which the Gem lamp will not accomplish as well as the ordinary carbon lamp. In Table V is a comparison of the useful life claimed for Gem 50-watt lamps in published data, and that estimated from a series of tests on lamps made during the past year.

TABLE V.

Voltage Range.	Published Estimates of Useful Life.	Useful Life Estimated From Recent Series of Tests.
1st or Top Voltage....	450	575
2d or Middle Voltage.	640	810
3d or Bottom Voltage.	940	1220



Various Styles of Tungsten Lamps.

Tungsten Lamps.

The regular multiple type of tungsten lamp is now available in nine different standard sizes, 40, 60, 100, 150 and 250-watt of the unit type; 40 and 60-watt meridian, (units of the large round bulb style) also 25 and 40-watt small bulb, comparable in size with ordinary 16-carbon filament lamps, and intended to replace the latter in fixtures, side brackets, etc., or in any other places requiring small lamps.

To illustrate the trend of changes to higher efficiency types, an interesting review is presented in the classification on the preceding page.

The excellent performance of the present tungsten lamp is sufficient to satisfy the most exacting purchaser. It is not too much to predict that it will soon be possible to produce in the larger sizes, a satisfactory commercial tungsten lamp at an efficiency of 1 watt per candle, and that this will be the efficiency ultimately adopted for the tungsten lamp. It will perhaps be interesting here to consider the manner in which some of the gains in efficiency are realized for the tungsten lamp.

The temperature at which the tungsten filament can be operated is much higher than with other filaments. This increase in operating temperature causes the filament to give off more of the short waves which produce light, and a smaller proportion of long waves which represent heat. Thus more of the energy expended in the lamp is represented in the visible spectrum. In addition to the advantage gained from a higher working temperature, there is a further gain from what is known as "selective radiation." The relatively higher ratio of luminous to non-luminous radiations with metal filaments, which is accomplished, as will be noted in Fig. 4, either by a decrease of radiation in the non-luminous part of the spectrum, (shaded part of the diagram) or by increased radiation in the luminous spectrum (white space in diagram).

Tantalum is said to possess this property to a greater extent than tungsten, and would probably be more efficient if it could be worked continuously at the same high temperature.

Filaments of metal are much better conductors than those of carbon, and to obtain the necessary resistance, great lengths must be used for the multiple

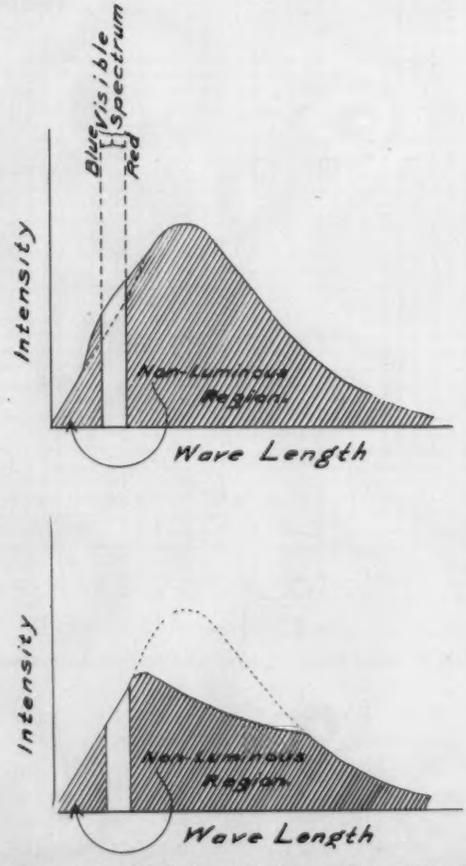


Fig. 4. Diagram by Prof. Amrine, University of Illinois, illustrating "Selective Radiation."

type of lamp, at least three times the length of the ordinary carbon filament. It is needless to say how troublesome it would be to satisfactorily dispose of some twenty or thirty inches of frail fibre in the small bulbs demanded to replace the old carbon lamps. Especially is this true of metal filament lamps for high voltages. An interesting study is offered in Table VI, showing relative the lengths, diameter and surface of various filaments.

TABLE VI.

Filament.	Effective Length Inches.	Mean Diam.	Effective area sq. Inches.	C. P. per sq. in. of Surface
Carbon 25 c. p.....	9.4	.0060	.1774	140
Metallized 20 c. p.....	9.5	.0037	.1108	180
Tantalum 20 c. p.....	23.4	.0018	.1324	151
Tungsten 100-w. 80 c.p.	28	.0029	.2551	313

Beside the ability to withstand high temperatures, we have another very good quality in the tungsten filament. low intensity per unit of surface. Fig. 5 gives a comparison of filament surface per candle-

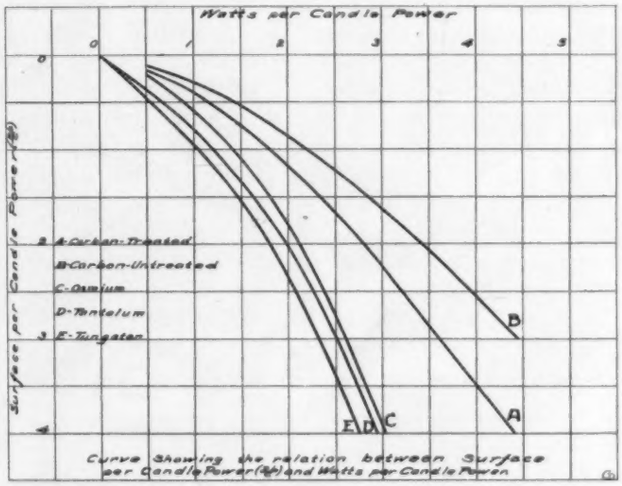


Fig. 5.

power with various lamps at corresponding efficiencies. The greater surface per candle allowed metal filaments make it possible to work them at a higher intensity without excessive deterioration.

It is well known that metals possess a positive temperature co-efficient; that is, for an increase or decrease in temperature, there is a corresponding increase or decrease in resistance. The temperature of a filament depends upon the current taken by it, which of course, hinges upon the voltage being maintained. As the resistance increases with temperature on increased voltage it thereby prevents the current rising in the same ratio as the voltage.

TABLE VII.

	CARBON.			TUNGSTEN.		
	Pr. ct. Volts.	Pr. ct. C. P.	Pr. ct. W. P. C.	Pr. ct. Volts.	Pr. ct. C. P.	Pr.ct. W. P. C.
Under Voltage.	80	28	216	80	43	162
	85	36	177.5	85	53.1	140.3
	90	52.3	145	90	67	126
	92.5	62.6	132	92.5	75	118.9
	95	76	120	95	82.9	112
	97.5	87.1	109.6	97.5	91.2	106.5
	100	100	100	100	100	100
Over Voltage.	102.5	115	91.8	102.5	110	95.4
	105	130.5	84.3	105	120	91.7
	107.5	149	77.2	107.5	130.4	86.8
	110	169.2	71.5	110	141.6	82.9
	115	205	63	115	164	76.2
	120	255	56.4	120	188	71

Table VII compares Tungsten and carbon filament lamps for candlepower variation with change of voltage. It will be noted that tungsten shows a considerable improvement over carbon in this respect, and therefore the tungsten lamp will be of increased value where the voltage regulation is poor, or at the end of heavily loaded circuits where there is considerable line drop during peak load.

Multiple Tungsten Lamps, 200-250 Volts.

In addition to the regular multiple 100-130-Volt types of tungsten lamps, the General Electric Co. have recently developed a full line of tungsten units for 200-250-volt service. The standard sizes are as follows: 45, 70, 110 and 180 watts. The average performance of these lamps is estimated to be fully equal to the excellent service given by the regular multiple type of lamp. Although more expensive than the latter, these new units show a greater comparative improvement due to the relatively lower efficiency and shorter life of the untreated filament generally used in the high volt carbon lamp. To those who can use the new high volt lamps, the data presented in Table VIII and Fig. 6. will be especially interesting.

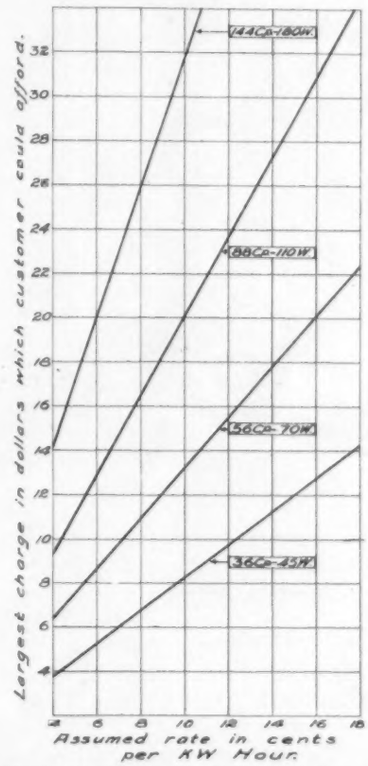


Fig. 6. The largest price which a customer could afford to pay for each 200-250-Volt Tungsten Lamp at various rates per K. W. Hour, assuming carbon lamps of equal candlepower supplied free.

TABLE VIII.

Number of Hours Burning at Various Rates per K. W. Necessary to Save Full Cost of High Voltage Tungsten Lamps.

Rates per K. W. Hour In cents	36 c. p. 45-w.	56 c. p. 70-w.	88 c. p. 110-w.	144 c. p. 180-w.
3	635	525	371	340
4	476	393	278	255
5	381	315	222	204
6	317	262	185	170
7	272	225	159	145
8	238	197	139	127
9	211	175	123	113
10	190	157	111	102
11	173	143	101	93
12	158	131	93	85
13	146	121	86	78
14	136	112	79	73
15	127	105	74	68
16	119	99	69	64

Improved Lighting for Consumers.

The advantages of tungsten lamps to consumers may be summarized as follows:

1st. Low cost of installation, as compared with arc or Nernst lamps.

2d. Simplicity of renewals and attendance.

3d. Low cost of operation.

4th. Adaptability with perfect results, to alternating or direct current.

5th. Flexibility of service, with wide range of low and high candlepower units.

6th. Quality of light, which resembles sunlight, is distinctly superior to any other form of artificial illuminant, except well diffused illumination from arc lamps. (The marked yellow cast of the gas arcs, glower and carbon filament lamps is lacking.)

7th. Remarkably slow decline in candlepower, so that tungsten lamps can be used satisfactorily until burned out.

Tungsten Economy Diffuser, Renaissance Style.

The recently developed merging prism Holophane reflectors furnish the most generally desirable candlepower distributions. The several types, extensive, intensive and focusing, are all bowl-shaped with crimped edges, differing very slightly in general appearance. For cluster lighting, a neat and efficient lighting unit of lower intrinsic brilliancy is obtained in the tungsten economy diffuser, "a lighting unit that turns down."

Central Station Policy.

Central station managers all over the country have watched with deepest interest the commercial influence of the tungsten lamp. To many it was a grave question whether the more general introduction of these lamps would not so reduce current consumption as to interfere with business. Because of this, and confronted with the development of low candlepower tungsten lamps, central station men were slow to recommend it for general use, but realizing the necessity of educating consumers along the lines of more light, and believing that the cheapening of the service would result in more than a proportionate increase in use, many lighting companies offered the lamps to consumers at less than wholesale prices. The companies introducing tungsten lamps in this manner have thus upheld and controlled to a large extent the wattage of the lamps installed. On the other hand, where the field has been left open for the indiscriminate sale of lamps, results have not been so satisfactory.

Years of experience in central station practice has demonstrated the fact that central station companies should have as complete control as possible over the lamps used on their circuits. This has been largely accomplished in the past by the system of free renewals, which, although desirable, is not at present possible with tungsten lamps, because of their high cost. Some companies are, however, maintaining the tungsten installation for the customer at a monthly charge per lamp, a plan used by the gas companies with gas arcs, and also with Nernst lamps.

It has been stated that electricity does not supply on the average over 25 per cent of the entire lighting. Admitting this to be the case, the central station manager should liberally advertise the tungsten lamp, and by its superior qualifications, endeavor to interest the many prospects now using other methods of illumination. It is a very good plan to make trial installations where possible; they rarely fail to gain a new or retain an old customer.

Summarizing Again.

Modern lamps mean to the central station:

1st. Success in meeting competition from all other forms of artificial illumination.

2d. Reaching a new and hitherto unapproachable class of customers by reason of being able to offer cheaper illumination.

3d. With consumers on flat rate, or where street lighting is paid for on candlepower basis, have increased station capacity, worth approximately $100.00 per kilowatt.

4th. Fewer isolated plant installations, by reason of cheaper illumination possible from central station service.

5th. Satisfactory and efficiently maintained lighting service, and at less expense for maintenance, due to the excellent candlepower performance and better quality of light delivered.

6th. Cutting down the cost of free renewals, where carbon lamps are supplied, as tungsten lamps will be purchased by the consumer through the central station or dealer.

7th. Improving annoying peak-load conditions, and at the same time maintaining revenue by the liberal placing of tungsten lamps in connection with day load current consuming devices, such as electric flatirons.

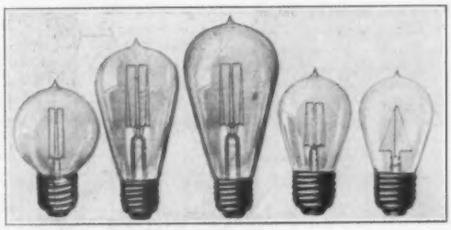
8th. Reducing somewhat the bad effects of poor voltage regulation. (Metal filaments, as compared with the carbon, suffer much smaller changes of candlepower and life for any change in voltage).

Compensators and Low Volt Tungsten Lamps.

Where it is necessary to install very small tungsten units, and where alternating current is available, compensators or small transformers are recommended to reduce the voltage. With 220-volt alternating current, this is about the most satisfactory method for obtaining good results from tungsten lamps, except with high candlepower units.

The majority of carbon lamps now in use are sixteen candlepower or less, and while it is important to increase the standard of illumination, many conditions call for a low candlepower lamp. To meet the situation with tungsten lamps requires a more hardy filament than would be possible with the regular multiple type. Low volt lamps are therefore desirable because the short sturdy filaments are less liable to breakage from careless handling, and give better life, approximating 1500 to 2000 hours without noticeable decrease in candlepower. For decorative lighting, small round bulb lamps are available in the low volt types.

Transformers of 250, 500, 1000 and 2000-watts capacity are in many cases preferable to compensators.



A B C D E

Fig. 7. Standard Low Voltage Tungsten Lamps.

A. 10 to 24 Candlepower 20 Volts, 2 1-16 In. Diameter, 15 and 25 Watts, 28 to 34 Volts, 2 5-16 In. Diameter.
B. 10 to 15 watts, 25 to 34 Volts, 2¼ In. Diameter.
C. 15, 20 and 25 Watts, 20 Volts, 20, 25 and 40 Watts, 25 to 35 Volts, 2⅝ In. Diameter.
D. 6 and 8 Candlepower Sign Type, 20 Volts, 1¾ In. Diameter.
E. 4 Candlepower, 5 Watts, Sign Type, 10 to 12 Volts. Also 6 and 8 Candlepower.

Though slightly more expensive than the latter, and with somewhat higher losses, the transformer is adapted to a wide variety of conditions. For instance, the primary winding is arranged for either 110 or 220 volts with two secondary circuits possible in each case, 11 or 22 volts, thus the one device may be used for standard low voltage tungsten lighting 20 to 25 volts, and in case of 220-volt primary, a center tap on the primary side provides 110 volts on a separate circuit for small fan motors and electric heating devices, which generally give better service on this voltage. The 11-volt tap on the secondary side may also be used for ringing electric bells.

The low voltage transformer, being of weatherproof construction and enclosed in an iron casing, is especially suited for tungsten sign lighting, where a single 10 or 12-volt circuit is desirable. In fact, this device is known as a sign lighting transformer.

Table IX shows the losses in the low volt transformers and house lighting compensators. In order to give a uniform secondary voltage, house lighting compensators are provided with six taps on the primary side for various voltages, as follows: 100, 105, 110, 115, 120 and 125. All taps on the primary side are brought out to a terminal block.

TABLE IX.

	Transformers.				Compensators.			
Capacity in watts.....	250	500	1000	2000	250	250	500	500
Number of circuits....					4	1	4	1
Core loss in watts.....	9.3	13.	24.	35.7	4.6	6.3	6.8	11.8
Copper loss in watts..	9.1	15.5	21.8	40.2	2.1	10.1	4.2	16.2

The core or iron loss will be constant at all loads, but the copper loss depends entirely upon the load carried. The figures given are the maximum loss at full load; below full load, the loss will be correspondingly less. These losses will remain practically constant through years of service in a transformer or compensator of correct design and construction, whereas the losses with such a device improperly designed, and constructed with an ordinary iron core, will rapidly increase with age.

The question has been raised as to the effect of a large number of low volt transformers and compensators on the regulation of lighting circuits, due to the power factor of this kind of a load.

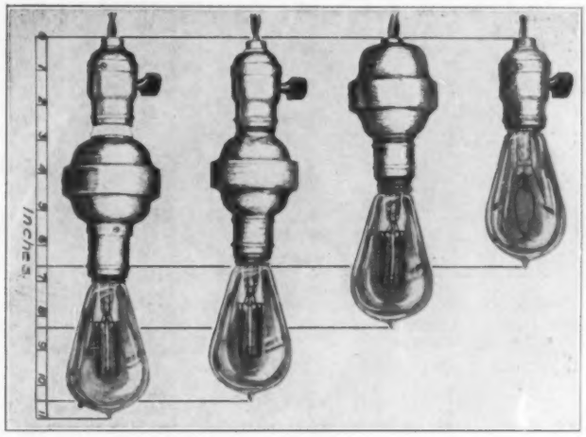


Fig. 8.

This question need give no concern if well designed transformers and compensators are used, as indicated by the high power factors shown in Table X.

TABLE X.

Per cent Load.	Per cent Power Factor. Transformer, Sign Lighting Type.	Compensator, Sign or House Lighting Type.
0	30	48
50	98	99.7
100	99.5	99.9

Where it is desired to employ only a few low volt tungsten lamps, or for outlets in remote places, the individual lamp compensator is recommended, primary voltages of both 100 to 130, and 200 to 230, ratio of 4 to 1 and 7 to 1, capacity 25-watts. The losses in these devices are trivial.

There are two styles of individual lamp compensators, the socket type, designed to screw in the ordinary lamp socket, and the fixture type, with bushing in the top similar to the ordinary socket. This device may be connected direct either to a drop cord, or an electrolier. As the compensators are keyless, they should be used on circuits controlled by switches.

Both of these styles are neat in appearance, and compact, being less than 3 inches in diameter. The exterior shell is of spun brass, obtainable in any finish. These compensators can be retailed for about $1.90 each.

Fig. 8 shows the individual lamp compensators, both socket and fixture type, compared in size with an ordinary socket and lamp, also with the original type of socket compensator. It is interesting to note the reduction in the size of the newer types.

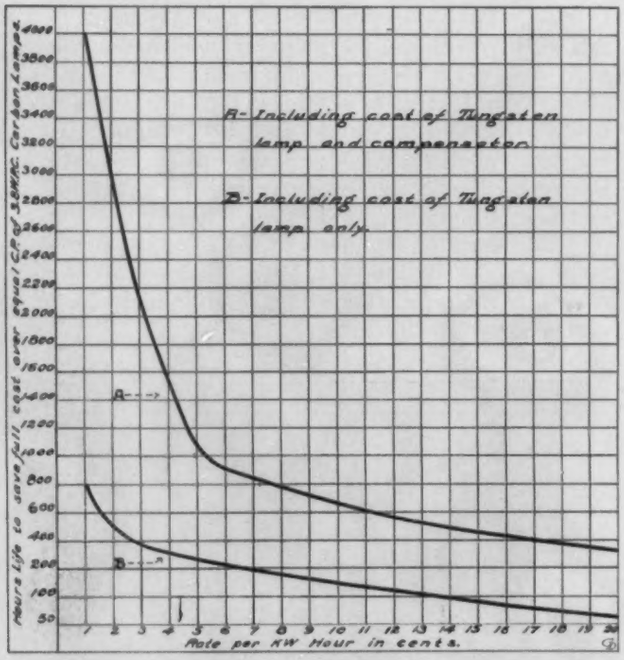


Fig. 9. Hours burning at which 20-watt Tungsten Lamps with Compensators Save Their Extra Cost Over 16 c. p. 200-volt Type Carbon Lamps.

Fig. 9 shows the hours burning necessary to save the extra cost of compensator and 20-watt tungsten lamp at various rates per kilowatt hour.

Tungsten Sign Lighting and Outline Work.

The sign lighting proposition has always been an interesting one. Many lighting companies make special inducements to secure such business, offering free signs, or flat rate signs. With alternating current the tungsten lamp is available for this service, securing an improvement of 75 per cent in efficiency or considering the extra cost of lamps and compensators a clear gain of 25 per cent to 40 per cent over signs equipped with carbon lamps.

The tungsten lamp, therefore, places this excellent method of advertising within reach of many consumers who have heretofore considered it beyond their means. Central stations desiring to further the use of current for this purpose should make the most of this new opportunity. Some interesting comparisons are afforded as follows: Cost of operating a ten-letter sign equipped with 100 4-candlepower lamps, burning 1000 hours, or approximately six months of service, at 4c per kilowatt hour for current, Tungsten vs. Carbon Lamps.

I. Cost of operating carbon sign.

Cost of current for 100 4 c. p. carbon lamps	$80.00
Cost of lamps, 100 at $.185 ea. (Stand. Pkg. Price)	18.50
	$98.50

II. Cost of operating tungsten sign.

Cost of current for 100 4 c. p. tungsten lamps	$20.00
Cost of lamps, 100 at $.425 ea. (Stand. Pkg. Price)	42.50
Cost of compensator	8.50
	$71.00
Net Saving, first 1000 hours	27.50
Net Saving, subsequent 1000 hours	36.00

The filament of the standard tungsten sign lamp consists of a single V-shaped loop designed to give a satisfactory end-on candlepower. Although the average life is upwards of 2000 hours, the curves, Figs. 10, 11 and 12, have been figured conservatively at 1500 hours life.

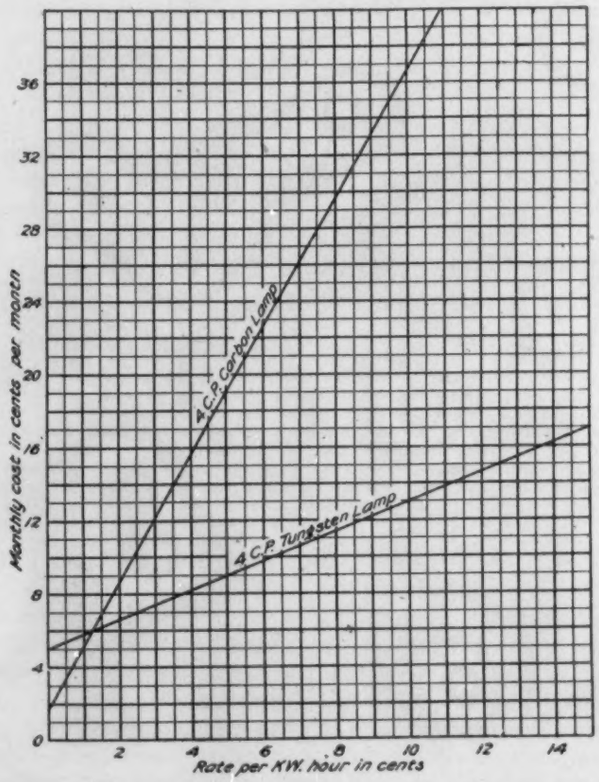


Fig. 10. Showing average monthly cost per lamp including current and renewals for a sign burning from dusk to midnight at various costs of current.

Fig. 10 gives a comparison of monthly operating cost per lamp, computed on the basis of 175 lamp hours, or dusk to midnight service every night.

Fig. 11 compares the hours of service obtained from signs equipped with tungsten and carbon lamps, for a given cost per lamp per month (10c). It also shows how much longer for the same cost a sign with tungsten lamps can burn than one equipped with carbon lamps.

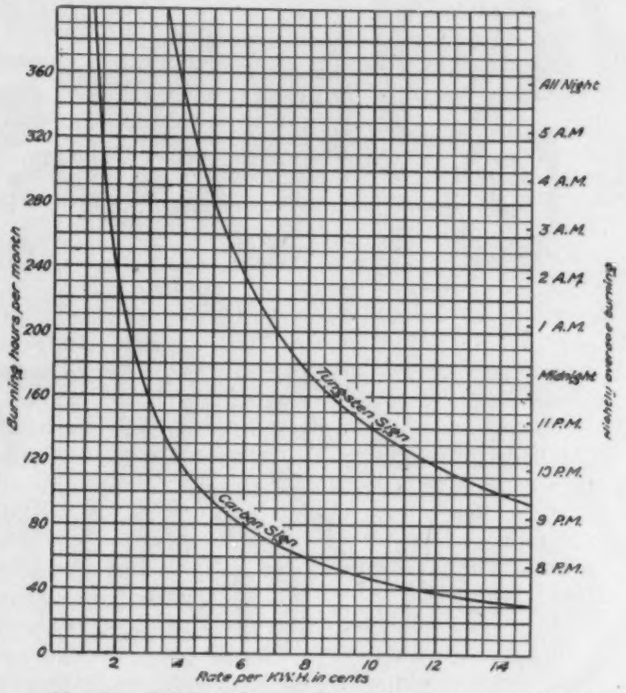


Fig. 11. Showing the number of hours per month a sign lamp can be burned to consume 10c. in current and renewals at various rates for current.

Fig. 12 shows, at various rates for current, the hours burning necessary for a tungsten sign lamp to equalize its higher first cost, indicating that at 4c per kilowatt hour, burning from dusk until midnight for two months (350 hours), its extra cost over carbon renewals is just offset.

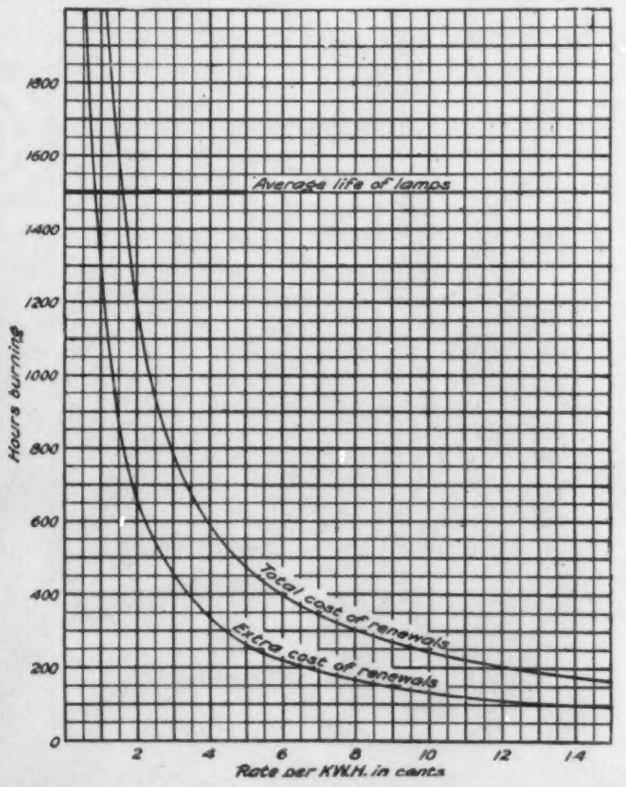


Fig 12. Showing the number of hours a lamp must last to have the total cost and the extra cost of renewals just offset the saving in current. Should the lamp last any longer than this, it represents a clear saving in current.

For tungsten sign lighting, 10 to 12-volt secondary circuits are advisable, using standard sign lamps. The sign lighting transformer previously described gives the required secondary voltage, either on 110 or 220 volts primary. By referring again to Table IX, we have complete data on the losses. For 100 to 130 volts primary, sign compensators are also furnished, ratio of 10 to 1, having ten secondary circuits. These devices are less expensive than the transformers. Table XI gives full data on capacity and losses.

TABLE XI.

No. of Letters 10 lamps per letter.	Capacity in watts.	Core or iron loss in watts.	Maximum possible copper loss.
1	50	.8	3.1
10	500	5.	8.
20	1000	9.	10.5

The copper loss given in the table is the maximum for unbalanced conditions. There will be no copper loss if the load is properly distributed, consequently the core loss is the only one to be considered.

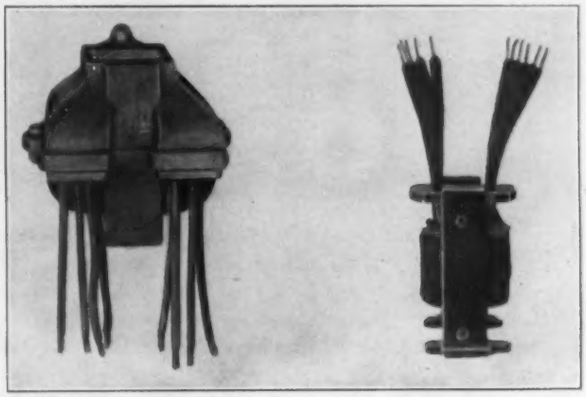


Fig. 13. Tungsten Sign Lighting Transformer.

Fig. 14. Tungsten Sign Lighting Compensator (Casing Removed).

Figures 13 and 14 show both compensator and transformer. The iron casing is of same general appearance for both.

In general a tungsten sign may be said to stand out in bold relief among its neighbors, for nowhere, perhaps, is the brilliant quality and peculiar penetrating power of the tungsten light more apparent than in this field of service.

Improved Street Illumination With Tungsten Lamps.

It is truly claimed that the carbon incandescent is now practically obsolete so far as street lighting is concerned. The tungsten lamp, enclosed in frosted globes, adds to the advantages of decorative lighting, fairly efficient illumination, a combination eminently desirable from an esthetic standpoint.

In Figure 15 we have cuts of ornamental electroliers used for street lighting in various important cities in the West. It will be interesting to note that this impressive and artistic method of street illumination had its origin on the Pacific Coast, being first employed extensively in Los Angeles and shortly after in Oakland, where of late the system has been extended to some of the residence streets. Seattle and San Francisco, also San Diego and several smaller town in the Pacific States, have recently taken up this scheme of lighting for the business districts.

There are several methods to be considered in equipping street electroliers with tungsten lamps.

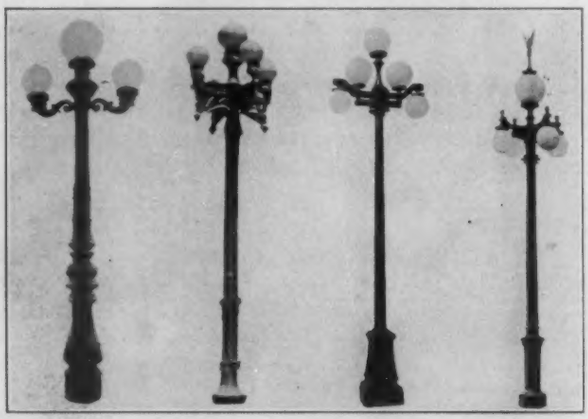
First, straight multiple system.

Second, low volt lamps and compensators.

Third, series multiple (low voltage lamps in series on 100-130 volts).

Electroliers equipped with 60 and 100 w. multiple lamps give excellent service in locations free from severe vibration.

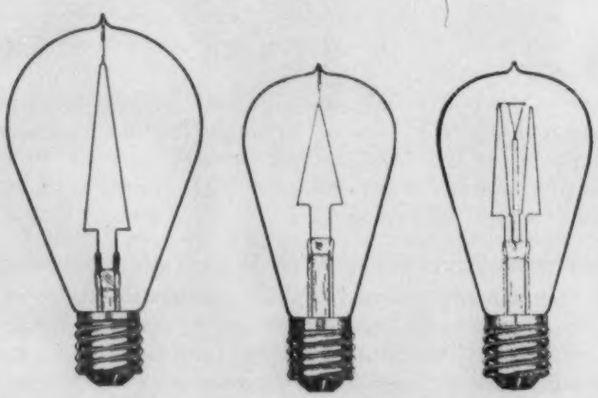
Multiple tungsten lamps are at present extensively used in San Francisco, Los Angeles, Seattle and Minneapolis, Minn., for this purpose.



Oakland. Los Angeles. Seattle. San Francisco.

Fig. 15. Ornamental Electroliers.

Low voltage lamps are procurable in all standard candlepowers, and are long lived, approximating 2000 hours, with very slight loss in candlepower. They have short rugged filaments and consequently are better adapted to withstand the severe jarring usually encountered in the business streets of a city.



25, 32, 40 & 60 c. p. 1.75 amp. 60 c.p., 3.5 & 4 amp.	25, 32 & 40 c. p. 3.5, 4 & 5.5 amp. 60 c. p., 5.5 amp.	80 c. p. 3.5, 4, 5.5, 6.6 & 7.5 amp.

Street Series Tungsten Lamps.

With alternating current available, small transformers or compensators may be installed in each electrolier. A capacity of 250 or 500 watts is usually sufficient, and without the iron casing, the compensator can easily be placed in the base of the electrolier by means of the hand hole, usually provided. The device, either compensator or transformer, is moisture proof, and can be obtained with different secondary voltages, as follows: 8 to 12, 20 to 25, and 27 to 30. Where compensators are to be used for this purpose, in cases where different voltages are encountered, extra taps can be provided on the primary winding so that the secondary voltages will be uniform. The low voltage lamp and compensator offers considerable compromise, and except in cases of direct current service, will probably supersede the regular multiple system in this field of lighting.

The series multiple system shows best results where the electroliers mount only three or four globes. It has the advantage of low volt lamps without additional cost for compensators. The one disadvantage is that one burn-out will put an entire electrolier in darkness.

A large number of electroliers recently installed in Oakland are equipped to burn four 50-watt 29-volt lamps in series multiple on 115 volts. Two lamps are placed in the center globe and one on each side; the total candlepower is 160. With four globe electroliers one lamp could be placed in each globe, and in either case, if desirable, the candlepower could be doubled, with 100-watt 29-volt lamps. On 125-volt circuits, electroliers mounting three globes can be advantageously equipped with three 75-watt 42-volt lamps of the regular street series type giving a total of 180 candlepower.

Series Incandescent Systems.

The high efficiency of the tungsten lamp greatly enhances the commercial value of the series incandescent system (with automatic regulation by means of constant current transformers).

With the series tungsten lamp outlying districts can be more economically lighted with lamps of relatively low candlepower, and the more closely settled districts with higher candlepower tungsten lamps or with series arc lamps, depending upon the conditions.

The incandescent street lighting system is particularly adapted to the lighting of residential streets, public parks and suburban districts where the heavy foliage demands frequent spacing of lights. In fact, since the advent of tungsten lamps in this field of lighting, many of the smaller cities and towns have changed over entirely to this method of illumination.

Generally speaking, arc lamps or other high candlepower lighting units are best utilized in locations where there is some reflection from near-by buildings, as in business streets, or at street corners in residential districts, where dense foliage is less apt to interfere.

In most other cases moderately low units of light, spaced at frequent intervals, will give better and more economical illumination, but where desired arc lamps may be connected in series with the incandescents with perfect results. To illustrate the saving possible with a series tungsten system, a concrete example would be a case where all-night street lighting was obtained from 280 32-candlepower 112-watt carbon lamps, connected in multiple. By substituting the new system mentioned, a net saving, figuring current at 2 cents per kilowatt hour, of over $300 could be effected the first year (after deducting the cost of new apparatus, $600, and tungsten renewals). The

net saving is approximately $1000 for every year thereafter. The table given herewith shows tabulated cost comparison:

I. Cost of New System.

32-kilowatt constant current transformer, complete with panel .....$	600.00
780 tungsten lamps, 32-candlepower, 40-watt (280 lamps, 3 renewals per year at $1.27)	990.60
Cost of current, 4000 hours at 2 cents.....	896.00
$	2486.60

II. Cost of Operating Old System.

1120 carbon lamps at 26 cents (280 lamps, 4 renewals per year) .....$	291.20
Cost of current, 4000 hours, at 2 cents ...	2508.80
$	2800.00
Cost of new system, tungsten renewals and current at 2 cents	2486.60
Net saving first year .....$	313.40

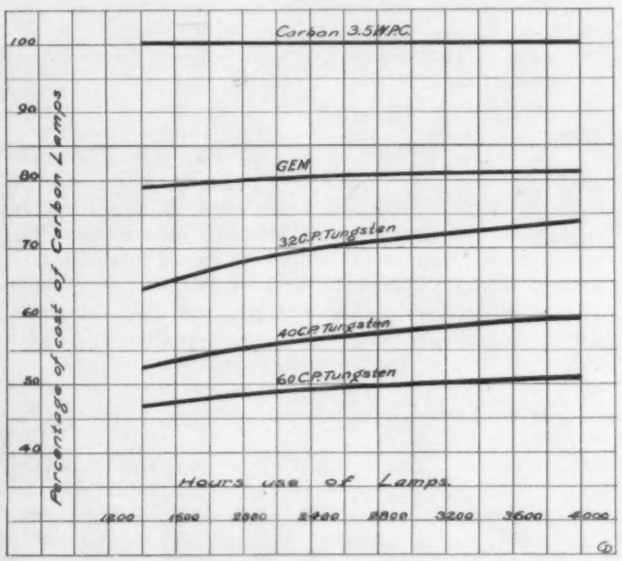


Fig. 16.

It is interesting to see such a graphic illustration as is given in Figure 16 showing the improved status of the incandescent street lighting business with the tungsten lamp, available for this class of service. The diagram brings out in a relative way the cost of producing a candle-hour of light from the tungsten, as compared with other street series lamps. This is estimated on the differential cost basis, covering fixed charges on investment cost, the cost of energy and lamp renewals as follows:

First. Generating cost proportionate to output covering fuel and station labor costs at a value (at the lamp) of 1 cent per kilowatt hour.

Second. Fixed charges on investment in generating apparatus taken at 12 per cent on $125 investment per kilowatt of capacity, giving a value per kilowatt of apparatus of $15 per year.

Third. Renewal costs of lamps as estimated from the following prices:

Carbon lamp .....$	.54
Gem lamp	.65
32 c. p. tungsten lamp	1.50
40 c. p. tungsten lamp	1.50
60 c. p. tungsten lamp	1.50

In Figure 17 are curves indicating the possible gain in income which can be secured from the same

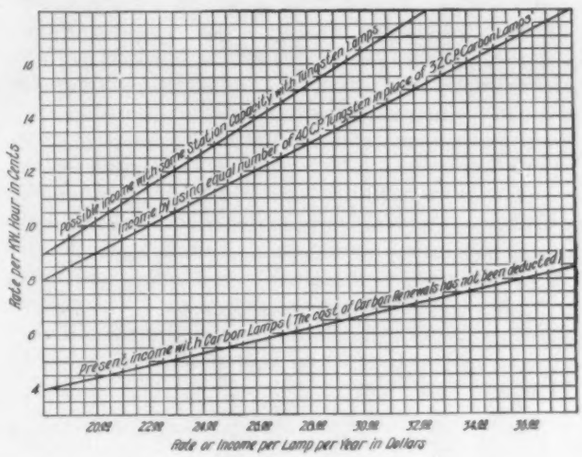

Possible income with same Station capacity with Tungsten Lamps.
(Income by using equal number of 40 C.P. Tungsten in place of 32 C.P. Carbon Lamps.)
Present income with Carbon Lamps (The cost of Carbon Renewals has not been deducted.)
Rate per KW. Hour in Cents
16
14
12
10
8
6
4
Rate or Income per Lamp per Year in Dollars

Fig. 17.

apparatus by substituting tungsten for carbon lamps, and the possible rate per kilowatt hour obtainable for current if the maximum number of tungsten lamps are installed, with the same transformer capacity.

SETTING A MARKET VALUE ON A WATER-POWER PLANT.

"The value of such a plant," so says Mr. Charles T. Main of Boston, "varies extremely with different conditions which govern the first cost, and with the character of the work done.

"The effect of the head, length of dam, length of canal, distance from canal to river, etc., increase or decrease the cost of construction. Very much better work is done in some places than in others, which increases the value and decreases the depreciation, so that no general rule can be given to cover all cases. The plant must be considered not alone, but in connection with the privilege, each being dependent upon the other, and each affecting the value of the other.

"For the water-wheels themselves, the average life of the wheel is probably about twenty-five years, while the casing might be allowed to outlive two wheels. Iron or steel penstocks, if taken care of, should last probably 100 years, but wooden feeders underground will not last fifty years. Wooden flumes, gates, and racks which are exposed to the weather will last about twenty years. Some wooden dams have lasted a great many years, but they are apt to get washed away in freshets. Stone dams if properly designed and well built, will last for hundreds of years.

"The market value of the wheels would depend somewhat upon their efficiency, independent of their physical conditions; for it might pay to replace them, if water is expensive, by wheels of higher efficiency.

PRESENT CONDITION OF UNDERGROUND WATER SUPPLY IN SOUTHERN CALIFORNIA.[1]

BY F. C. FINKLE, C. E.

Southern California has now passed through the experience of a quarter of a century in the development and use of underground water. During that time history has been making at a rapid rate. There has been overdevelopment in many localities which was not apparent at first on account of the high average precipitation from 1884 to 1894. But from 1894 to 1904 the mean rainfall was below the average and heavy drafts with light inflow began to depress the underground water level rapidly.

Few, indeed, understood the laws of nature governing underground water in those days, and thorny was the path of the hydraulic engineer, who did know and sought to make his clients look at the matter in a scientific manner. As an example of a report which was not heeded the speaker will read the following from his own pen, dated November 2, 1890, and addressed to the Board of Directors of the East Riverside Irrigation District, while he was chief engineer of that District.

To the Honorable Board of Directors, East Riverside Irrigation District, East Riverside, Cal.

Gentlemen: At the request of Directors Robinson and Dixon I have made an examination of the Garner and McKenzie ranches on the west side of Lytle Creek with respect to their value for water development. The Garner ranch and that portion of the McKenzie ranch, not sold to the City of San Bernardino, aggregate about 66 acres of land, most of which is water bearing. A small part of the McKenzie ranch is over the dike, which limits the artesian basin, but this is valuable for constructing an intake reservoir.

Artesian wells can be developed on all of the remainder and the 500 inches of water needed by your district secured from 15 or 16 wells. I base this on the experience acquired by me in making developments on the McKenzie place as Chief Engineer of the new water works for the City of San Bernardino.

As many other tracts of artesian land such as the Lord, Schimpf, Raynor and Ferguson ranches as situated adjacent to the tracts you are about to purchase, I deem it advisable to consider the effect of further developments on all the tracts. The number of wells now on these tracts is not so great as to make any overdraft on the natural supply of water, even after the necessary additional ones are bored to yield 500 inches for the East Riverside Irrigation District.

Yet, it is understood that those interested in these water bearing lands, as well as the City of San Bernardino, owner in part of the McKenzie place, intend to make further developments. If their plans are carried out, as well as yours, the water supply tributary to the Lytle Creek-Cajon branch of the San Bernardino Artesian Basin will be overdrawn, and the flow of all wells therein greatly diminished, while the wells most unfavorably situated will cease to flow.

This may lead to the installation of pumping plants to obtain the required water supply from these diminished wells, as the further driving of artesian wells, in overdrawn territory, cannot increase the output of water. Such pumping plants will, however, not greatly increase the available supply of water. There will, of course, be a saving of waste now occurring in the non-irrigating season, as companies, who are careless in regard to capping wells when not needed, will not pump water to be wasted on account of the pumping cost. The lowering of the water plane below the surface will also save part of the evaporation now occurring in this basin, should pumping be adopted generally. But, on the whole, it is my opinion that the resulting gain in water will not equal the probable overdraft, as attorneys inform me that no legal remedy can be invoked to prevent overdevelopment. The result of unrestricted development will, therefore, be (1) boring of wells as long as new wells will increase the supply, (2) the installation of pumping plants and (3) a progressive lowering of the water plane.

In this future scramble for water you will be as well off as any one, since you will be near the lower end of the basin, enabling you to drive a tunnel to tap the wells on the higher land at some distance below the surface. But I am optimist enough to believe that such expensive measures will not be required. I base my opinion on the following:

Up to the present time the people generally have acquired very little knowledge of the underground water sources. They mostly believe that such water supplies are unlimited and that more development is the only matter worthy of consideration. There are three things which may be carried out to counteract the tendency to overdevelopment of underground water basins. These are as follows:

First. Legal proceedings on the part of those first in right. Although, under existing decisions, this may seem hopeless, the courts are usually quick to appreciate the necessity of modifying apparently established rules, when public policy, the general good and the future safety of large investments require it. Even if no legal relief is secured good would result by disclosing through expert testimony and arguments of counsel the fact that underground water supplies are not unlimited and must be developed to the extent of the supply only.

Second. Artificial charging of the underground water basins. At present only part of the run-off from the watersheds sinks into the washes and feeds the underground water strata, whether artesian or surface water strata. The remainder goes to the sea in the form of flood discharge. Much more can be supplied to the underground water supplies by spreading these wasted flood waters over the broad washes or turning them into shafts, pits or wells in the debris cones near the mountains.

Third. Educational work by water company officials through publication in newspapers and printed reports of such information and facts as bear on the quantity of underflow available for development in different sections, the necessity for preventing waste and the methods applicable to artificially increasing the subterranean water supplies.

The first two of these need only be considered as future policies to be adopted, when conditions shall make them advisable, but co-operation among water companies and districts to educate the public, in regard to the limitations, proper use and methods of replenishing underground water supplies, is a present necessity.

To be specific in regard to your case I would say that the watersheds tributary to the Lytle Creek arm of the San Bernardino Artesian Basin probably yield a run-off about 5000 inches under a four-inch pressure continuous flow. Of this some 20 per cent probably sinks to the artesian basin and the remainder is nearly equally divided between surface diversions and storm run-off. Hence there are about 1000 inches continuous flow obtainable from this district including the flow of natural springs, cienegas and artesian wells.

Any much greater draft than this will draw on the reserve and become disastrous in the end.

Still there are two thousand odd inches of flood water now wasted from the watersheds above, much of which can be saved by the construction of dams for spreading it over the gravel and sand washes below the mouths of Lytle Creek and Cajon Canyons and the excavation of shafts and pits in these washes to absorb flood water. This work must be undertaken in the future to provide water for those requiring it and you are justified in regarding it as a future asset.

In view of these conditions I advise you to purchase these properties, to make them the source of supply for your district

[1]Paper read at Seventeenth Annual Irrigation Congress, Spokane, August.

and to develop and protect your water supply therefrom as hereinabove recommended.

Respectfully submitted,

F. C. FINKLE,

Chief Engineer East Riverside Irrigation District.

San Bernardino, Cal., November 2, 1890.

Note—The inch of water referred to in the above report is that used in Southern California, one inch being the two one-hundreth part of a cubic foot per second.

The only part of the report, which was heeded was the advice to purchase the lands, the boring of wells and later, when the wells ceased flowing, the driving of a tunnel and pumping. Nothing was done to conserve water and restore the depleted water plane, and finally the Riverside-Highland Water Company, which succeeded the East Riverside Irrigation District, became involved in litigation as one of the defendants in the noted case of Barton et al. vs. Riverside Water Company, et al.

This case was brought on the theory of law as laid down in the famous case of Katz vs. Walkinshaw, 141 Cal. 123. Whatever others may have imagined, the speaker, who was called as an expert for the plaintiff's in both the Katz case and the Barton case, always believed, that the chief advantage to be derived from either of these cases would be to define more clearly the law as applied to percolating water in California, and to educate the people to conserve and replenish the underground water supplies.

In the first of these, expectation was much more than realized, as the Supreme Court of California did more than clearly define the law, and in the Katz case was laid down for the first time in California the doctrine of correlative rights in percolating waters, as had previously been done in the Long Island Garden cases in New York.

In regard to educational benefits, all that could be hoped for was realized. The Katz case was a most powerful educating agency, and at the second hearing of the case by the Supreme Court, some twenty of the leading water lawyers of the State appeared as amici curiae, which showed the widespread interest it had aroused.

The Barton case became even more of an educational medium, because of the large amount of expert testimony introduced dealing with the natural laws affecting underground water, its use and conservation. Hence, the Barton case, although barren of results so far as limiting the drafts of any of the defendants from the San Bernardino Valley, showed them clearly that the supply of that Valley was being overdrawn and measures must be taken to replenish that supply. Such measures were taken and the result is best shown by what has occurred in that valley since.

The Barton case was tried in 1905, which year also marked the beginning of active water conservation to restore the depleted water plane in Southern California. In this connection it may be noted that the level of the underground water plane had been declining rapidly throughout Southern California since the year 1896, and had reached its lowest point in the latter part of 1904 and the early part of 1905. Much alarm was felt on this account, many claiming that the decline was a permanent overdraft and due wholly to the extensive developments of underground water, while others asserted that it was caused by a deficiency in the precipitation.

It was always the speaker's opinion that both causes were responsible for the decline, but that abstractions of water from subterranean sources were so great in many localities, that even the return of as high a precipitation as had ever occurred would not in itself repair the damage. While the return of a higher precipitation would temporarily arrest the decline and cause a rise in most localities, the fact that more than the average supply was being withdrawn in many places could be satisfactorily demonstrated.

In the meantime, those interested in the preservation of the underground water sources were asked to co-operate and expend some money to store flood water in the gravel beds. This had ben advocated by many engineers in private reports for 10 to 15 years prior to 1905, as in the report hereinabove reproduced, but with little or no effect. The short sighted policy of water companies and others interested in the subject was to draw as long as this was possible by deepening their wells and lowering their pumps. They disliked to admit that the combined drafts were greater than the supply, and it is probably a fact that most of them honestly believed they were not, as it was commonly asserted that with the return of "normal precipitation" the water plane would rise to its former elevation in spite of the withdrawals.

Prof. E. W. Hilgard of the University of California was the first to advocate through a public print the artificial storage of flood water in the valleys of Southern California. This appeared in the report of the U. S. Department of Agriculture for 1901 on "Irrigation Investigations" in separate No. 2 on "Subterranean Water Supply of the San Bernardino Valley" by E. W. Hilgard, at page 133 under "Storage." But no heed was taken of it by those it was intended to warn, although the engineers generally heartily endorsed Prof. Hilgard's suggestions, and underground water conservation.

As no attempt to carry on such work was made the inevitable result was abundant and expensive litigation. Many of the resulting suits came to trial from 1900 to 1905, and the expert testimony in these suits was the first thing to convince everyone that something must be done to avert disaster. The expert engineers, who testified in Court, were not entirely agreed as to the extent of overdraft on the under ground water supplies in different localities, but all were agreed, that active artificial replenishment by spreading the storm waters to fill up the voids below the surface was necessary.

The educational effect of this was such, that those interested in the preservation and permanency of underground water consulted their engineers, who advised them to divert the unused flood waters during the rainy season and spread them over the most porous debris cones and washes in the valleys, or to turn them into shafts and wells reaching down to the water plane below. It began to dawn on them that this would produce the desired result, as nature creates this underground water by infiltration from water flowing in the drainage channels. It was merely an attempt to increase the efficiency of nature, by making the area exposed to infiltration greater. Instead of having the

flood water pass over a narrow strip 10 to 50 feet in width, it meant to have it cover a width many times as great for the same distance, and to turn as much of it as possible down into shafts and wells where it would be forced out into the surrounding soil under pressure. In this way great volumes of waste water flowing to the ocean during every rainy season in Southern California could be conserved.

This kind of work, while yet in its infancy, has been carried on for several years in a few localities, and its beneficial effect is now evident from the results actually obtained. In order to illustrate this, the following four tables are given, giving a typical rainfall record in the great valley of Southern California, extending from the sea to Redlands, and the available records of water fluctuations in three wells located in different parts of the valley.

The first table is the seasonal rainfall at San Bernardino, about fifteen miles west of the head of the valley and sixty miles east of Los Angeles. This is the longest complete rainfall record in the valley and represents the seasonal fluctuations occurring in the whole valley. The record was kept by Mr. S. P. Waite from 1870 to 1891 and by Dr. A. K. Johnson from 1891 to 1909.

Table No. 1.

Seasonal precipitation at San Bernardino, California, 1054 feet above sea level:

Season July 1 to June 30	Rainfall in inches	Season July 1 to June 30	Rainfall in inches
1870-71	13.94	1890-91	18.08
1871-72	8.98	1891-92	14.35
1872-73	15.10	1892-93	19.82
1873-74	23.81	1893-94	8.13
1874-75	13.65	1894-95	20.98
1875-76	19.90	1895-96	8.11
1876-77	9.52	1896-97	16.74
1877-78	20.33	1897-98	8.24
1878-79	11.54	1898-99	7.49
1879-80	20.36	1899-00	8.64
1880-81	13.50	1900-01	17.36
1881-82	11.54	1901-02	11.15
1882-83	9.17	1902-03	17.42
1883-84	37.51	1903-04	9.37
1884-85	10.81	1904-05	20.78
1885-86	21.83	1905-06	19.88
1886-87	14.50	1906-07	23.17
1887-88	17.76	1907-08	15.62
1888-89	20.27	1908-09	17.61
1889-90	25.45		
		39 year mean	15.97

The second table is a well record in the San Bernardino valley giving the depth to water from the surface of the ground. This well is now known as the Oldecker well, and was formerly called the Arthur Palmer well. It is situated near the intersection of Mount Vernon and Highland avenues, San Bernardino, in what was at one time the St. Elmo townsite. The record has been kept by the speaker himself and his engineering assistants.

Table No. 2.

Table showing maximum height of water in Oldecker well, formerly Arthur Palmer well, for each season since 1887-88:

Season.	Depth to water from ground. Surface in feet.	Season.	Depth to water from ground. Surface in feet.
1888-89	25.3	1899-00	71.9
1889-90	25.9	1900-01	87.4
1890-91	24.5	1901-02	91.8
1891-92	25.8	1902-03	94.6
1892-93	25.5	1903-04	96.2
1893-94	24.7	1904-05	92.1
1894-95	23.9	1905-06	80.9
1895-96	24.5	1906-07	64.8
1896-97	26.0	1907-08	57.3
1897-98	35.8	1908-09	50.1
1898-99	50.3		

The third table is a record of the water level in the J. B. Neff well near Anaheim, Cal., being in the lower end of the valley, while the Oldecker well just given is in the upper end of the valley, about seventy miles further east. Mr. Neff is authority for these levels himself, but the record only goes back to 1898.

Table No. 3.

Table showing maximum height of water in Neff well, for each season since 1897-8:

Season.	Depth to water from ground. Surface in feet.	Season.	Depth to water from ground. Surface in feet.
1898-99	23.0	1904-05	49.6
1899-00	34.0	1905-06	49.1
1900-01	39.1	1906-07	38.8
1901-02	41.5	1907-08	37.0
1902-03	44.0	1908-09	38.1
1903-04	45.5		

The fourth table gives the water levels in San Antonio Water Company's well No. 3, between Upland and Cucamonga, Cal., about twenty-two miles west of San Bernardino. The record is from the expert testimony in the case of Cucamonga Vineyard Co. et al. vs. San Antonio Water Co. et al., recently tried in the Superior Court of San Bernardino before Judge Frank F. Oster, and most of the measurements were participated in by the speaker.

Table No. 4.

Table showing maximum height of water in San Antonio well No. 3, for certain seasons since 1888-89:

Season.	El. of water above Sea level.	Season.	El. of water above Sea level.
1889-90	1449.2	1905-06	1351.3
1900-01	1403.6	1906-07	1376.0
1903-04	1349.0	1907-08	1382.2
1904-05	1345.7	1908-09	1382.1

There has been more or less effective work done towards charging the gravel beds both in the San Bernardino basin, where the well in table No. 2 is situated, and in the Cucamonga basin, where the well in table No. 4 is located. The former well has risen 46.1 feet above its lowest point and the latter 36.4 feet. This difference of nearly ten feet in favor of the Oldecker well is due to the more effective work done by the Riverside Water Company in conserving flood water by artificially saturating the gravels of the San Bernardino valley, although the San Antonio Water Company has also done very effective work of the same kind in the Cucamonga basin.

It must not be imagined that the use of the underground reservoirs has yet reached a state of perfection. The art is yet in its infancy and crude as it were. But the people are learning rapidly and ways will be found to store most of the waste water in these subterranean reservoirs.

What is needed now is a decision of the Supreme Court of California fixing the status of water thus conserved. In justice and to aid the development of California this question must be settled, and from the able manner in which the Supreme Court has handled water questions in its decisions heretofore, there need be little fear as to the result.

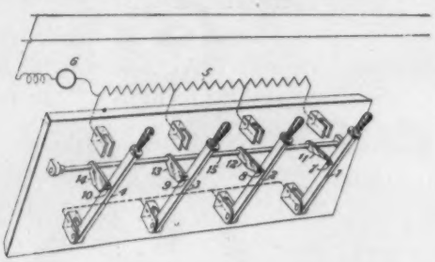
In conservation of flood water let the following maxims be borne in mind:

If the water can be pumped from a well, it can also be stored in the same well.

If nature saturates underground reservoirs by covering limited areas with flood and waste water, man can still further saturate these reservoirs by covering greater areas.

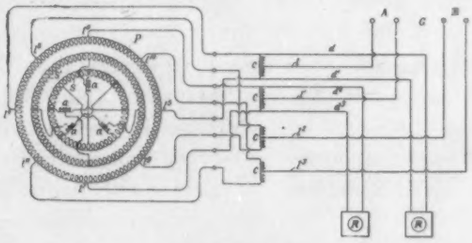
PATENTS

931,148. Multiple-Switch Rheostat. Otto S. Schairer, Pittsburg, Pa., assignor, by mesne assignments, to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. The combination with a series of independently actuated switches,



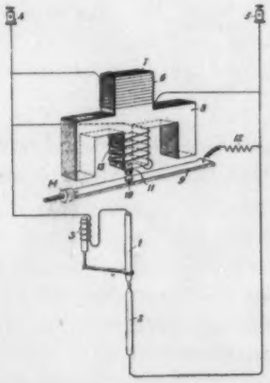
of a plurality of interconnected dogs mounted for rotative movement to prevent each switch, except the first of the series from closing unless the next preceding switch is closed.

931,136. Variable-Speed Alternating-Current Motor. Ralph D. Mershon, New York, N. Y. In an alternating current machine, the combination of a primary winding having poles produced therein; a secondary element adapted to have current induced therein corresponding to poles in the said primary



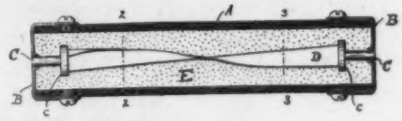
winding, and capable of inducing other poles in the said primary winding; and means for closing the circuit or circuits of current induced in the said primary winding.

931,168. Arc-Lamp. Samuel P. Wilbur, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. In an arc lamp, a cut-off device comprising a magnetizable core of substantially E-shape but provided with an auxiliary projecting portion on the side opposite to the three main



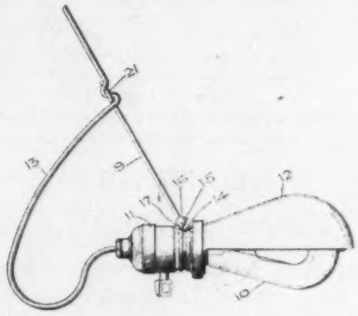
projections, a magnet winding connected in shunt to the arc and mounted upon the auxiliary projecting portion of the core, a magnet winding mounted upon the central main projection of the core, and a switch for controlling the circuit thereof that is actuated by an armature for the core.

931,477. Inclosed Fuse. Frederick P. Poole, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. An inclosed fuse having a sheath with conductors and



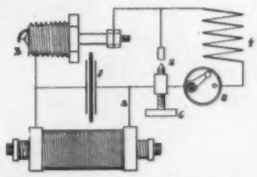
between the conductors a link piece, the edges of which are cut away to form a fusing point, intermediate the ends and the latter rolled, substantially as described.

931,162. Adjustable Drop-Light Bracket. Perry L. Tenney, Alameda, Cal. In a bracket the combination of an arm, an S-shaped friction wire-engaging member on said arm, a flattened and serrated portion on the opposite extremity of said arm, a ring having loops formed thereon, said loops being



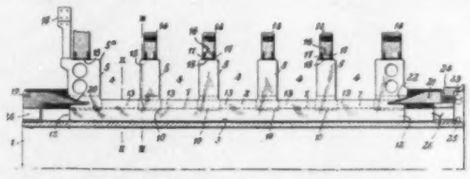
flattened and having one face thereof serrated for engagement against the serrated portion of said arm and a thumb screw disposed through said arm and said loops for securely holding said ring in adjusted position.

930,855. Indicator for Spark-Plugs. Alfred C. Hall, Sebastopol, Cal. In combination with an electric circuit, a spark



gap and a reactance coil in series therein, an adjustable spark gap in shunt with said reactance coil, and a switch in series with the reactance coil, substantially as described.

931,130. Commutator for Dynamo-Electric Machines. Benjamin G. Lamme, Pittsburg, Pa., assignor, by mesne assignments, to Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa. A commutator comprising a bushing or cylinder, a plurality of notched bars or segments disposed on



the surface thereof in radial planes to form annular projections, wedge blocks interposed between the bars or segments in the annular projections for establishing ventilating passages longitudinally adjacent to the surface of the bushing and radially between the annular projections.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Secretary and Managing Editor

DIRECTORS

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604 MISSION STREET, SAN FRANCISCO

TELEPHONE - - - - - - - - - KEARNY 918

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year.	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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NOTES.

One piece of insulating tape on the wire is worth ten in the supply room.

It is reported that the woman suffragists will present a protest against the substitution of the "suspendered" type of insulator for the petticoat style.

One effect of the heavy import duties on oil now imposed by the Japanese Government is the construction of two new steamships to burn coal instead of oil fuel, although their sister ships are equipped for the latter.

Conservation of underground waters as described in this issue by Mr. F. C. Finkle, should offer a valuable suggestion to hydro-electric and irrigation companies unable to catch all the annual run-off in the usual type of reservoir.

The practice of purchasing coke on the basis of net dry weight recently adopted by the Pacific Coast smelters is a step in the right direction, one that leads to the purchase of all fuel on its heating value, which is now being advocated by the leading engineers.

Simultaneously with the discovery that the new Lincoln penny can be used instead of a nickel five-cent piece in the telephone nickel-in-the-slot, two French inventors have perfected a magnetic detector which will allow the machine to operate only when a nickel coin is inserted. Thus does science circumvent dishonesty.

The announcement of the successful operation of the electric iron smelting plant at Heroult in Shasta County, California, is succeeded by the news that the Irondale Steel Company is building a small steel plant to be operated in connection with its blast furnace at Irondale, near Pt. Townsend, Washington. As this is the first serious attempt to manufacture steel west of the Rocky Mountains, its outcome will be watched with great interest, as the future of the steel industry on the Pacific Coast will be greatly influenced thereby.

Not the least interesting of the papers at the forthcoming session of the American Mining Congress at Goldfield, Nevada, on September 27 to October 2, 1909, is the report of the committee appointed last year on the standardizing of electrical equipment in mining work. This report should be of great value, not only to mining operators, but also to manufacturers of electrical equipment in obviating the present lack of uniformity in the installation of electrical equipment at mines. An invitation has been extended to anyone, having any views on this subject, to send them to Dr. Ed. B. Rosa of the Bureau of Standards, Washington, D. C., Chairman of the Committee.

Improved Lighting

There is nothing that has had a more pronounced influence on the commercial side of electric supply than the discovery that a filament of metallic tungsten, made incandescent by the passage of an electric current, is about three times as efficient source of light as a similar carbon filament. This is because tungsten, subjected to a higher temperature and possessing to a marked degree the property of selective radiation, converts more of the energy to light and less to heat.

Yet, notwithstanding this great gain in efficiency, it has been estimated that only two per cent of the available energy is converted into light in the most efficient type of incandescent lamp yet devised. In other words, perfect efficiency would require that 50 candle power be produced from one watt. This estimate does not include the vast loss of energy between the coal pile and the transformer, though the responsibility for this should not be placed upon the lamp-maker, for this remarkable inefficiency is common to all other known sources of light except, perhaps, that cold light from the fire-fly and the glow-worm. Though there thus remains ample opportunity for even greater strides in improved lighting, the tungsten lamp now has the best efficiency yet attained, and we find it displacing other means in almost all classes of service, in spite of most diligent research to devise some other practical form of incandescent lighting as a substitute.

Stanislaus High Tension Transmission

The trend in high tension transmission practice has been ever upward since a few daring spirits in southern California transmitted alternating current at 10,000 volts on the lines of the Pomona plant a short sixteen years ago. Today there are a number of lines with ten times that voltage, one of the most interesting being the Stanislaus transmission system, which forms the latest link in the great network carrying Sierrian power to San Francisco Bay. This system is the embodiment of the latest ideas suggested in connection with the safe and economical long distance transmission of hydro-electric power.

Great towers of steel nearly seventy feet high and placed six to the mile, have taken the place of the old wooden poles. Three separate circuits, each carrying 20,000 k. w., are to be operated between the power plant and the main sub-station, thus providing for continuity of service. The engineering and structural difficulties involved in a great transmission line, such as this, are paramount with those met by the bridge builder. In its one hundred and thirty-five miles of length it is subjected to the climatic extremes of mountain, valley and coast. It is built to withstand both floods and winds. The various members in the four-leg type of tower were first theoretically designed so that all stresses would be equally distributed and the assembled structure strained until the weakest member gave way, when a stronger one was substituted in its place; this being continued until a satisfactory tower was obtained. A novel method of anchoring these towers by means of a bifurcated leg and metal plate is also noteworthy.

The greatest interest, however, attaches to the suspended type of insulator, which has been substituted for the petticoat. The power thus transmitted is to be used in the operation of the street railways in San Francisco, as the original Stanislaus Electric Power Company has been acquired by the Sierra & San Francisco Power Company, which also owns the United Railways of San Francisco.

The Architect and the Engineer

It is seldom that the sorry plight of the sufferer from another's ignorance is more graphically portrayed than in the "Cheerful Idiot's" ludicrous description of a modern steam plant that is published this week. The conditions described, while hardly typical of all isolated plants, are yet so frequent as to demand some radical action to prevent possible perpetration in the future.

The writer, a capable steam engineer, is expected to furnish continuous service at reasonable economy from a faultily designed steam plant. The fault lies not with the installer, but with the architect, who attempted to economize space by crowding the most important part of the whole building into a series of cunningly designed holes. As the author intimates, the arrangement would make an excellent model for a rabbit warren, where the chief requisite is inaccessibility and privacy, but as an abode for a self-respecting engineer, it is a dismal failure.

The people who installed the plant were confronted with a problem much like storing away machinery in a gigantic piece of Swiss cheese. Unfortunately, however, they left no room for the operating engineer to crawl into the several holes where repairs are needed, as repairs inevitably are. When it requires thirteen hours for an experienced man to turn off a motor commutator and when one-third of the fuel bill is due to a poorly designed steam plant, is it any wonder that the conscientious engineer adds a few biblical expletives to his vocabulary, or sarcastically refers to the wisdom of providing two holes in the barn door, a large one for the large cat, and a small one for the small cat?

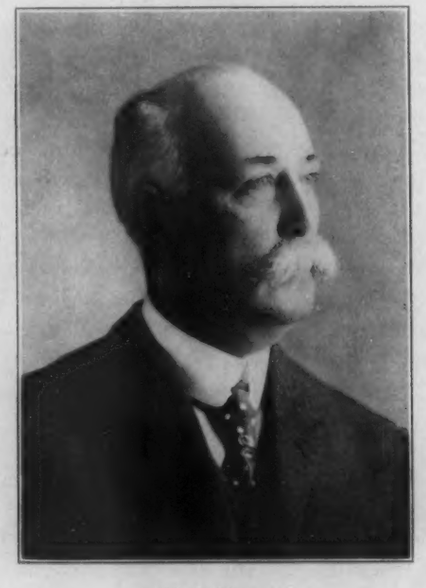
For the sake of the engineer, we must state that this monstrosity was designed by an architect, who in turn, was employed by an owner, either too parsimonious to hire a competent engineer, or too short-sighted to realize that the initial cost is but a small proportion of the total expenses of a power plant. There are many excellent isolated installations running smoothly and economically that attest to the wisdom of employing a plain, practical mechanic or engineer to design a plant to be operated by engineers. It would be fitting retribution if the supervising architect who permitted the construction of such a perversion was condemned to run it and act as a buffer between the owner and the dissatisfied tenants.

JOURNAL PORTRAITS

W. S. Heger, recently appointed manager of the Los Angeles office of the Allis-Chalmers Company, is one of the pioneer machinery men of the Pacific Coast, having been actively associated with the largest manufacturers of power and electrical apparatus for the last twenty years.

Mr. Heger opened the initial offices of what has since become the General Electric Company, on the coast in 1889 at No. 4 Sutter street, under the title of The Edison Company for Isolated Lighting, which company was succeeded in rotation, due to reorganization, by the Edison United Manufacturing Company, the Edison General Electric Company, and finally by the General Electric Company.

Resigning in 1891 from the Edison Company, on account of his daughter's illness, Mr. Heger returned to the Coast in 1895 and established the office of the Westinghouse Electric Manufacturing Company, whose Pacific Coast manager



W. S. Heger

he remained until 1895, when he resigned to become assistant to the president of the Allis-Chalmers Company. He now returns to the Coast to devote his time to the upbuilding of this company's business in Southern California.

Mr. Heger is an enthusiastic Coast man, and his reception by his many friends, coupled with his evident delight at being once more in the West, indicates a repetition of his former successes.

THE YALE & TOWNE WORKS EQUIVALENT TO A COLLEGE.

A student of Sibley College, Cornell University, inquiring as to how much credit he would obtain for shop work done during the vacation, was told that it was the practice to give one hour's credit for every two hours devoted to actual work in a shop or foundry, provided the latter were approved by the faculty as a proper place for gaining useful experience.

Asking if the Yale & Towne Works at Stamford would fit this description, he was informed that double credit would be given for any time spent in these works, as, in the opinion of the faculty, it was the full equivalent of the instruction given at the college, and that in this respect it ranked with a very few of the leading industries of the United States.

PERSONALS.

G. B. Lukes, with Stone & Webster, was in San Francisco last week.

K. G. Dunn, vice-president Hunt, Mich & Co., San Francisco, will return this week from Seattle.

F. H. Woodward, Standard Electric Works, is out again on crutches after his accident of last week.

W. G. B. Euler, construction foreman with the General Electric Company, is in Arizona on a brief trip.

James H. Crossett, general manager of the Visalia Electric Company, was in San Francisco last week.

H. H. Jones of Sand Point, Idaho, manager of the North Idaho & Montana Power Company, was in Spokane recently.

F. E. Corwin, Pacific Coast manager of the Bryant Electric Company, is spending a two weeks vacation in the mountains.

Robert Schorr, consulting mechanical engineer, San Francisco, is in the East, and will return the latter part of September.

David Dorward Jr., chief engineer Union Oil Company, is expected in San Francisco the latter part of this week from the East.

E. B. Parsons of the San Francisco office of the Westinghouse Electric & Manufacturing Company, is at Newcastle, Cal., on a vacation.

W. J. Davis Jr., electrical engineer of the Pacific Coast branch of the General Electric Company, has returned from a trip throughout the Northwest.

E. L. Sherwood, sales engineer with the lamp department of the San Francisco office of the General Electric Company, left this week for Seattle and the East.

S. G. Gassaway, engineer, with the San Francisco office of the General Electric Company, was married August 28, to Miss S. C. Scott at Belvedere, California.

Jay P. Graves, president of the Inland Empire Railroad at Spokane, has been ill for the past two or three months of typhoid fever, but is now able to be about.

D. C. Martin, in charge of the pumping machine department of Fairbanks, Morse & Co., of San Francisco, has returned from a two weeks' vacation in Sonoma county.

W. H. Reed, vice president of the Corliss Gas Engine Company, has bought out the Cunningham & Campbell Pattern Works in San Francisco, and will devote most of his time to this enterprise hereafter.

E. A. Hunt of the supply department, T. E. Carden of the auditing department, and H. E. Duren of the sales department of the General Electric Company, have recently joined the Portland office of this company.

Sakutaro Satakke, president of the Tokyo Electric Lighting Company, and Michio Doi, president of the Osaka Electric Lighting Company, are due in Seattle on September 2, as members of a party of prominent Japanese who will make a tour of this country.

Frank H. Hill, who has long been identified with the sales and engineering department of the New York office of the Sprague Electric Company, assumed the duties of manager of the branch office in Atlanta, Ga., on September 1st, in place of Mr. F. V. L. Smith, who has resigned.

Mr. Harold A. Buzby, secretary of the Keystone Lubricating Company, makers of the well known lubricant, Keystone Grease, is making a two months' tour of the company's western branches, taking in Chicago, Denver and San Francisco, and visiting the smaller sales offices as well. He will return about September 1st.

PROGRAM JOINT CONVENTION

Northwest Electric Light and Power Association and Seattle Section A. I. E. E., Seattle, Washington, September 7, 8 and 9.

SEPTEMBER 7.

10:00 A. M. Address of Welcome—Governor M. E. Hay and Mayor John T. Miller.
Response for A. I. E. E.—John Harisberger, Chairman Seattle Section.
Response for N. W. E. L. & P. Assn.—Mr. Pierce, counsel for Rogue River Electric Power Co.
Address—"General Electric Conditions," Ralph W. Pope, National Secretary A. I. E. E.

2:00 P. M. Paper—"Modern Incandescent Lamp and Improved Lighting," E. L. Sherwood, S. F. office General Electric Co.
Discussion.
Paper—"Telephone Practice," C. E. Fleager, Pacific T. & T. Co.
Paper—"Electrical Illumination from the Central Stations' Basis," W. M. Hamilton.

SEPTEMBER 8.

10:00 A. M. Report of Committee on Rates—M. C. Osborne, Washington Water Power Co.
Discussion.
Report of Committee on Uniform Accounting—Frank Dabney, Seattle Electric Co.
Discussion.
Paper—"Methods of Handling Complaints"—J. H. Whittaker, Seattle-Tacoma Power Company.
Discussion.
"Electrically Heated Household Appliances"—A. G. Jones, S. F. office, General Electric Co.
Discussion.

2:00 P. M. Executive Session.
Election of officers.
Report of Secretary; report of Treasurer.
Paper—"Conservation," Franklin G. Griffith, counsel Portland R. R., Light & Power Co.
Discussion.

SEPTEMBER 9.

10:00 A. M. Executive Session.
Discussion.
"Publicity Accounting for Municipal Public Service Departments"
(a) J. E. Frost of State Board of Trade; from standpoint of a State officer.
(b) E. Porter, Martin Ramsdell, C. N. Huggins; from standpoint of public corporations.
Paper—"The Electric Vehicle as Corrector of Load Factor," W. J. Grambs, Seattle Electric Company.
Paper—"Employers' Liability and Indemnity," Arthur Gunn, Wenatchee Electric Company.

The Standard Engineering Company, mechanical engineers and constructors, announce their removal from 60 Natoma street to the Hooker & Lent Building, 503 Market street, corner First, San Francisco. C. F. Braun is manager, L. G. Russell, mechanical engineer, and J. M. Williams, secretary and treasurer of this firm, which represent the Alberger Condenser Company, Minneapolis Steel and Machinery Company and Robb-Mumford Boiler Company. They are completely equipped for all power plant and general mechanical design and construction.

SAN FRANCISCO SECTION A. I. E. E.

Ralph W. Pope, of New York, secretary of the American Institute of Electrical Engineers, has been delegated as a representative of the Institute to attend the annual Conservation Congress at the Seattle Exposition, in the latter part of August; and while on the Pacific Coast he has determined to visit the several Sections of the Institute in Seattle, Portland, San Francisco and Los Angeles.

Mr. Pope contemplates being in San Francisco for a few days on or about September 18th, and it is the desire of the local Section to give an informal dinner in honor of Mr. Pope's visit. Mr. Pope will give an informal talk, devoted principally to Institute affairs, and on account of his long familiarity and experience with the Institute, his subject will be most interesting.

This is the first visit of its kind that has ever been authorized by the Institute, and prior to the final notice giving the date of the dinner it is hoped that each and every member will interest his friends and spread the word in order that we can have an attendance of over two hundred and fifty at the dinner.

Through the courtesy of the Home Telephone Company, the meetings of the San Francisco Section A. I. E. E. will be held in the Assembly Hall in the new building at 333 Grant Ave. The firm of McMeen & Miller have kindly donated to the Section, chairs, tables, a stereopticon and a screen for use at their meetings. At a regular meeting of the executive committee held on August 17, the following committee on papers was appointed for the ensuing year: C. W. Burkett, electrical engineer, Pacific Telephone & Telegraph Company, chairman; H. Y. Hall, electrical engineer, Southern Pacific Railroad; A. H. Halloran, managing editor Journal of Electricity, Power and Gas.

NEW CATALOGUES.

"Making More Motor Money" is the title of an attractive booklet being distributed by the Standard Electrical Works of San Francisco, and illustrating and describing Hubbell Polarity Plugs.

The Standard Electrical Works, San Francisco, has issued an attractive bulletin on the Jandus Regenerative Flame Lamp, which is claimed to be the longest burning flame lamp in the world, seventy hours without trimming.

Bulletin No. 115 from the Electric Storage Battery Co. is devoted to the application of storage batteries to isolated lighting and power plants with particular reference to the installation of "Chloride Accumulators" in the Hudson Terminal Buildings.

"Tungsten Lamp Logic" is the title of an attractive booklet issued by the General Electric Company, illustrating and describing various types of tungsten lamps; the application of the tungsten lamp to office, store and home is further illustrated in booklet entitled. "Evolution in Lighting, Due to a New Lamp."

The engineering department of the National Electric Lamp Association, in Bulletin 8A, illustrate and describe tungsten miniature and low voltage lamps, 1½ to 20 volts, including automobile, general battery, novelty battery, dental, optical, surgical, large low voltage and sign lamps. Bulletin No. 9 is an interesting paper on the "Conservation of Our Natural Resources Through the Use of High Efficiency Lamps," by S. A. Doane.

The Western Electric Company at New York and Chicago is distributing a bulletin illustrating and exploiting the Sunbeam Tungsten Miniature Lamp for use on voltages between 1½ and 20. These lamps vary in efficiency from .9 watts per candlepower to 1.33 watts per candlepower, and are particularly desirable for use in automobiles, flash-lights, signs, dental, optical and surgical instruments.

NEWS OF THE STATIONARY ENGINEERS.

PREAMBLE.—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.

Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.

California.

No. 1. San Francisco. Thursday, Central Hall, 124 Fulton St. Pres., A. C. Arbuckle. Sec., Herman Noethig, 900 York St.

No. 2. Los Angeles. Friday, Eagles' Hall, 116½ E. Third St. Pres., Gabriel Allen. Fin. Sec., Harry Notthoff, 1307 Winfield St. Cor. Sec., W. T. W. Curl, 4103 Dalton Ave.

No. 3. San Francisco. Wednesday, Merchants' Exchange Bldg. Sec., David Thomas, 914 O'Farrell St.

No. 5. Santa Barbara. Geo. W. Stevens, 2417 Fletcher Ave., R. R. No. 2.

No. 6. San Jose. Wednesday. Pres., W. S. Pierson. Sec., Leal Davis, 350 N. 9th St.

No. 7. Fresno. Pres., J. F. Wagoner. Sec., F. J. Whitney, Box 8.

No. 8. Stockton. Thursday, Masonic Hall. Sec., S. Bunch, 626 E. Channel St. Pres., Jos. Gieger.

Oregon.

No. 1. Portland. Wednesday, J. D. Asher, Portland Hotel. Pres., O. H. Reed.

No. 2. Salem. A. L. Brown, Box 166.

Washington.

No. 2. Tacoma. Friday, 913½ Tacoma Ave. Pres., Geo. E. Bowman. Sec., Thos. L. Keeley, 3727 Ferdinand St., N., Whitworth Sta.

No. 4. Spokane. Tuesday. Pres., Grant Tuttle. Sec., J. Thos. Greeley, 0601½ Cincinnati St.

No. 6. Seattle. Saturday, 1420 2d Ave. Pres., J. H. Beckman. Sec., J. C. Miller, 1630 Yesler Way.

Practical letters from engineers and news items of general interest are always welcome. Write your items regardless of style. Communications should be addressed to the Steam Engineering Editor.

SAN FRANCISCO NO. 1.

A meeting of San Francisco No. 1 was held August 26th at 124 Fulton street. The educational committee reported every detail in readiness for the lecture to be delivered by Mr. E. B. Parsons of the Westinghouse Electric Manufacturing Company, and in the near future will have lectures on Super-heated Steam by Mr. James H. Smith, and on oil burning and accessories by the firm of Staples & Pfeifer Co. Much interest was shown at the lecture by Mr. Parsons, there being about 90 members and visitors present which was followed by queries on the many problems on the alternating current and ably answered by Mr. Parsons.

WASHINGTON NO. 4.

Frank Teed has been chosen president of Washington No. 4 of the National Association of Stationary Engineers of Spokane. Frank Berry is the new vice-president of the local; Thomas, Greely, secretary; John Duling, financial secretary; William Norwick, treasurer; James David, conductor; George Schofield, doorkeeper; Charles Shively, Frank Berry, George Schofield and L. E. Porter, educational committee. The local association now has a membership of 80, 20 new members having been added during the last month.

CALIFORNIA NO. 3.

The August 25th meeting of California No. 3 was a very interesting one, owing to the fact that three candidates were initiated. There are nine applications on hand. The new members are James S. Richards, James Gaston and Earl W. Button. The hall committee has been purchasing some new furniture for the meeting room which is now cosily furnished. At the conclusion of the routine business, an open meeting was declared to give the members an opportunity of meeting Mr. O. W. Lillard, who is representing the Gould Storage Battery Co. Mr. Lillard gave a preliminary talk on an illustrated lecture which he gave before No. 3 Association on September 1, at their rooms in the Merchants' Exchange Building. This lecture was a valuable one to the progressive engineer as the subject is one which the engineers cannot afford to overlook, owing to the common practice of installing storage battery systems in conjunction with plants which are subject to extremely fluctuating loads.

THE MODERN STEAM PLANT.

I beg to say, as a preface to the following remarks that this article is not intended as a joke. I am led to write it in the hope that it may do some good both to the owners of plants as well as to the stationary engineers. What I have never been able to understand is, why the average business man and property owner is so shrewd and careful in almost everything connected with his establishment except the steam end. A property owner concludes to erect a building. Nobody would ever accuse him of doing this either for fun or philanthropy. He does not accuse himself of any such nonsense. He puts up that building solely for the purpose of realizing a more or less handsome return for money invested; his lot perhaps is not very large, but he wants to get as much building on it as possible; therefore, what he lacks in ground area, he makes up in height.

Modern building laws are very strict, and everything in the building line must conform to them to the letter. Note how carefully this owner picks out his architect. Note how carefully he goes over the specifications or at least thinks he does. Then, when he imagines himself thoroughly satisfied, he turns the whole business over to his architect who in turn proceeds to let the various contracts; the owner, meanwhile perhaps goes to Europe, fondly thinking, that in the course of time he will return and find that he has the finest building ever. No doubt this will be true so far as appearances on the surface go, but how about mechanical details? From what I have seen the average architect knows as much about detail, that is mechanical detail, as a frog knows about pants pockets. They neither know, nor will they take advice from anyone who does. Wherein they may be likened to the tenor robusto in a grand opera company, and the things that they do to the unfortunate steam plant may be likened to the "Peace of God, which passeth understanding."

I am very much inclined to think that the architects who were responsible for the mess in which I am now wallowing, must have been descended from rabbits, for everything connected with the steam plant in this place is down in a little hole, causing me to believe more than ever in the Darwinian theory and this is supposed to be a modern plant.

It will be conceeded by all that one of the most important adjuncts to a modern building, if not the most important is the elevator service; failure in this service causing all kinds of dissatisfaction and probable loss of patronage, therefore loss of revenue. Yet in many cases the elevator machinery is placed in the most impossible location, where it can neither be seen, got at, nor given the commonest care. As an instance, I have one electric elevator in this building and every time I look down at the motor and winding gear (I have to look down at it, for it is in a little hole), I raise my hat in admiration for the man who built it and

had the courage of his convictions so splendidly developed that he consented to allow his machinery to be placed where it is. While my hat is still off, I offer up a prayer for the architect. If my prayers are answered he will certainly get his just reward. This particular hole is so small, that no one may with safety get down into it without first pulling the main switch; for, should a person be down there when the elevator moved, he would be either wound up on the drum or mixed up with the controllers. In this particular connection I may say that we have holes within the hole, one hole having been made in the concrete wall so that room might be found for the commutator end of the motor, while the other hole was made also in the concrete wall for the reception of one of the brake magnets, making a very compact installation. It became necessary some time ago to turn off the commutator of the motor, of course necessitating the temporary removal of the armature. Now, under proper conditions with reasonable room to work, this armature should have been taken out in an hour. A spare armature put into the fields and coupled up in another hour, or, lest any one should consider this rushing things, let us say three hours for the complete job. As a matter of fact this very simple repair job took over thirteen hours to accomplish, because the motor had to be taken out bodily, unbolted from its bedplate, hoisted up, turned round and lowered down again before the armature could be reached at all. The same process of course had to be gone through in reverse order in the reassembling of the parts. All this was very good for the shop, but very inconvenient for the tenants of the building, who one and all prayed for me so fervently that I kept out of sight for three days.

The steam plant in this building is fearfully and wonderfully made and reflects great credit on the author of its being. I am saying nothing against the actual machinery, which is all of good modern standard make, but the arrangement of this machinery is the most extraordinary of any I have ever had personal charge of, and I have come across some very funny things in my perigrinations around the country in the last twenty-five years. In this particular case we are burning easily 50 per cent more fuel than we ought, owing entirely to faulty arrangements. This steam plant consists, exclusive of auxilliaries, of one boiler, three small steam pumps, a small air compressor, a hot water heating system and a heating system for the building. The auxilliaries are merely two oil pumps, and a feed pump which is connected to the return trap from the heating system, this pump not being connected to any other source of supply. Inasmuch as the heating system is not in operation during the summer months, there is no water in the receiver, consequently no feed water for the boiler, the feed pump therefor may be said to be quite useful. I would like to say also quite ornamental, but as it is down in a little hole, where it can't be seen, I cannot really say exactly what it does look like.

A man dropped into see me the other day; he was a stranger, and being of a naturally polite disposition, I of course asked him what I could do for him? He replied, "Oh, nothing; I am merely looking around; I put in this pump and receiver!' If I had only had an axe! As I could not get hold of one without opening a tool box, and fearing he might take fright before I could get hold of something else, I thought I would temporize with him, and begged him therefor to say no more on the subject, nor to tell any one else that he had done the job, but I asked, "If you found it necessary to put this pump and receiver down in this hole, why, oh why don't you make the hole big enough for a man to get down with it?" "Ah," said he, "The architect provided the hole, I only put the outfit where I was told." I was rather glad afterwards that the axe was locked up.

My disposition is considered sunny, and perhaps many may wonder why I entertain such naughty, wicked feelings towards him who caused this pump to be put down into this little hole. I will say in justification, that the plungers of this confounded pump which was expected to pump water at a temperature of at least 200 degrees were packed with square flax, and about a week before the advent of the man who stowed it away in its little hole we found it necessary to repack it. This operation was extremely simple and consumed over four hours of valuable time, because we had to disconnect the suction and discharge pipes, cut off the steam and exhaust pipes (there being no unions in sight), stand the pumps up on end, pack it, put it in place again, and connect it up. In the meantime, having not other means of getting the water into the boiler, we had to shut down, and as I had to do most of the work myself, I could not well get out of the way, but had to smilingly take all the compliments of the season from the tenants of the building.

Now, about 350 feet away from the boiler we have two steam pumps and an air compressor, all of which are down in a little hole, and about 75 feet further on we have a deep well pump, also down in a little hole. I don't know which of these two installations is the more unique, they are both, however, well in keeping with the rest of the plant. There is a cafe in the building and the deep well pump is very cleverly put down into its little hole under the cafe floor. It is quite true that it is under the sidewalk, but they were careful to put an I beam in the sidewalk right over the pump and when the plunger rod broke in two a while ago we had to rig shears in the dining room and spread the component parts of the pump out on the tables, having previously carefully removed the glassware and table cloths and made the necessary repairs. This pump gives no trouble now, because after having done all this work we found that we had no water in the well, so we don't use it. But the other two pumps we have to use, because having no water in the well we are compelled to patronize Spring Valley, and while we pay full water rates we have to pump the water from cisterns through the building simply because the Spring Valley pressure is not sufficient to distribute it.

The water system is also unique, as is also the hot water heating system. I took charge of this plant late at night and the assistant engineer kindly showed me around. About 100 feet from the boiler we came to two heaters. He informed me that one was the high pressure system and the other the low. I was duly impressed and not wishing to display too much ignorance and thereby lose caste, said "just so." We then travelled along some dark passages and finally came to this room where two pumps reposed snugly side by each in their little hole and underneath two large receivers, some 54 inches in diameter by 20 feet long, placed one above the other. My assistant informed me in an awed sort of way that these were the receivers for the "Kewanee Water System." I was duly impressed again and foolishly asked why the Kewanee system was found necessary in this case. He looked at me in a pitying sort of way and said, "Why for two reasons, the receivers are placed in the basement so that the water can't freeze, and to do away with tanks on the top of a building in a country subject to earthquakes." I have since done away with all pendulum clocks in my house, and substituted those having a spring and escapement, lest I might wake up some morning and lose track of the time owing to the former style of clock having stopped during the night.

Having been duly impressed some more with what he had told me I asked him why there were two receivers or accumulators, as he called them. He said one was the high and the other the low pressure system. Now when he showed me the two heaters and said one was the high and the other

the low pressure system I, as I said before, refrained from asking any questions, thinking that perhaps for some rea son or other (which I should be able to discover upon further acquaintance) one was heated by live steam and the other by exhaust, but when he spoke of a high and low pressure cold water system, I though I might venture to ask why, without lowering myself in his estimation (I am very sensitive), he pointed to the pressure gauges and said: "You see, this receiver has 60 lbs. pressure on it, while this one only has 25 lbs. This high pressure receiver takes care of the house from the second floor up—while this low pressure receiver takes care of the house from the street floor down. I was again duly impressed and asked him if the heaters he had recently shown me were handled along the same lines and he assured me that they were. I then asked him who designed this somewhat remarkable system and he supposed it was the architect. Off came my hat. I couldn't help it. I had to pay due respect to the man who had provided two holes in the barn door. A large hole for the large cat and a small hole for the small cat. I thought it showed a liberal spirit, especially as I was afterwards informed that this cold water system cost $7500 to install, and as we only have 126 available rooms for the accommodation of guests I thought this seemed quite reasonable.

Now as to these two steam pumps, as I have said before, they are down in a little hole, under these receivers. The hole is conveniently and commodiously built, so that to oil the pumps the engineer must crawl around on his hands and knees, and should it ever become necessary to take a plunger out of one of the pumps the said plunger must be sawed into at least three pieces. And as neither one of the pumps are connected up so as to be in anyway interchangeable, when anything happens to either one or the other, one end of the building at least must necessarily be without either hot or cold water. We have only a very small reserve tank on the roof, fed from this system so that if the pumps stop for a short time or a slight leak occurs, or some one, acting upon the principle of "cleanliness being next to godliness" takes a bath, the whole building is without water. The water is pumped from cisterns into these receivers and an air pressure maintained on them by an air compressor by means of which pressure the water is distributed through the building. In other words, if we depended on our well, we should need three steam pumps and an air compressor to keep this little building of only 126 rooms supplied with water. The building is heated with live steam, the water for the building is heated with live steam, the ventilating fans are driven by electric motors, and the exhaust steam from everything goes overboard and the water of condensation is pumped into the sewer, to the tune of about 1700 gallons a day. When I asked why this water was not sent back into the boiler I was told that there was an objection to doing this on account of the cylinder oil. I ventured to say that I thought that the small amount of cylinder oil used here should not cause any trouble, but when I was informed that they had used 25 gallons in a month and a half, I thought that it might be just as well that the water of condensation went overboard instead of into the boiler.

We have only one boiler, and we are under steam 24 hours out of the 24. Therefore we cannot wash out. I am unable to say what the outcome of this is going to be; in the meantime my gray hairs, which are all I have to show as an evidence of early piety, are rapidly turning red. I have made some little changes, which help. Among other things I have raised a family of four cats and I am able to vent my ill humor on them, which is fortunate, as no one at home will stand for it.

Now to recapitulate; that is a fine word whether it fits in here or not I don't quite know, but it goes. This plant was installed under the supervision of an architect, and I want to say that in no one particular have I gone outside of actual facts. I could say much more but time and space is limited and I must not trespass too much upon the good nature of the editor of this paper. One thing more, however, may be of interest, all the sewer outlets are so arranged that the water has to be swept up hill to them. I have not yet been able to get any explanation as to why this is thus. I would in all kindness ask the prospective builder of a house to think carefully in the matter of his steam plant, and consider the advisability of employing his own engineer right from the start, and pay him wages in keeping with his position, so that he will look after the owners' interests faithfully and thoroughly. Let him not wait until the plant is turned over by the contractors to the architect, and after the architect has turned it over to him hire an engineer and then when the engineer calls his attention to faults, abuse him and accuse him of being a very expensive man.

Have the plant installed thoroughly and in a mechanical way from the start under the supervision of a man trained for years in this particular profession, not wait until the plant is installed and then kick because the engineer wishes to make changes which are absolutely necessary for the welfare of the plant and the whole building. Neither the contractor nor the architect are practical running engineers or machinists and never go into details. They are prone to forget many items which are indispensable to the successful ruuuing of the plant. If a firm of ship owners contracts to have a ship built they appoint their own marine superintendent and their own engineering superintendent who are on the spot from the time the blue prints come out until the ship goes into commission; why does not this rule apply to the construction of a large commercial building? The answer is lack of education on the part of owners. Good engineers, thorough mechanics, can be had at any time, and their appointment at the right moment would save the owner of a building thousands of dollars.

The Engineers' Association, which is an organization of broad-minded, thinking, trained mechanics, and which has been in existence for nearly 30 years, has very recently closed a Mechanics' Fair which was the wonder and admiration of visitors to San Francisco and residents alike. If these men were not trustworthy, if they did not command the respect of the community, could they have carried an undertaking of this kind to such a successful termination as they undoubtedly did? I think not. Therefore, it behooves owners of buildings to look into this matter carefully for their own interests and thereby save an immense sum of money.

In conclusion let me say, that if in this particular instance some one with good horse sense and mechanical ability had had the looking after of the installation of the steam machinery in this building, the owners thereof would have been saved many a heartache and many a dollar. My manager comes down to see me once in a while and he says, "Chief (he always calls me chief, because he likes to see me swell up), we are burning too much fuel." I smile and say, "Yes, sir, at least 50 per cent." He shakes his head and goes away. And I want to say, that this is the only instance in my career where I have felt really ashamed to hold out my hand at the end of the month for my pay—which I must admit, is in this case very liberal. We hope in the near future to remodel things and increase the size of the plant. In talking over the prospects with the manager I have told him to measure off my space, when the time comes for the new engine room. "He and the architect can do what they like with the building but that little space down in the little hole must be mine," he assures me that it shall be so, and as he is a liberal minded man, who fully realizes the mess we are in he undoubtedly means what he says.

THE CHEERFUL IDIOT.

ON THE GENERATION AND APPLICATION OF ALTERNATING CURRENTS.

BY E. B. PARSONS.

While the term "Alternating Current" is very commonly used and fairly well understood among electrical men, it is still a mystery to most laymen. However, it is not as mysterious as it seems, and the purpose of this paper is to endeavor to explain some of its workings and methods of generation and application.

SINGLE PHASE CURRENTS.

Single phase currents may be likened to the action of a single crank engine. At a certain period maximum power is exerted, the effort gradually decreasing to zero, then increasing to maximum then again decreasing to zero and again to maximum. This

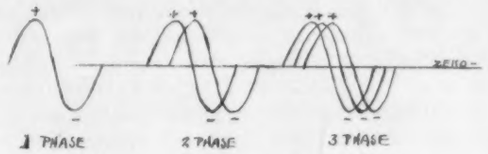


Fig. 1.

covers one complete cycle. Imagine a line drawn at the zero level, (Fig. 1), then generate a current which gradually increases until it reaches maximum positive: then let this current decrease to zero; then rise to a maximum negative, thence decrease to zero and you have described the action of a single phase current. This is exactly what occurs in the armature conductors of *any* electric generator, whether an alternating or direct current machine. In the single phase A. C. generator the armature conductors are connected to two terminals only—in the revolving armature type these consist of two collector rings—in the revolving field type, of two leads only—the conductors being so grouped that the flow of current at any instant is uniform in direction through all coils, *i. e.*, at a certain instant all coils will have currents generated in them which are positive in respect to one terminal and negative in respect to the opposite terminal, whether connected in series or parallel. Reverting to the single cycle, assuming that a coil is passed over a pole face generating a positive current maximum, that the next coil is passed over a pole face generating a negative current maximum, and that the inner terminals of these coils are connected together, and that terminals are connected from the outer ends to the line and you have a rough development of single phase A. C. generator armature winding (Fig. 2).

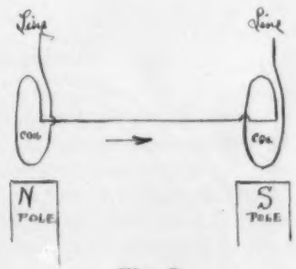


Fig. 2.

Now drive the revolving element (either armature or field) at such speed that each of these coils will pass across the face of a pole or poles at the rate of 60 times per second, or 3600 times per minute, and you have a 60-cycle single phase generator.

POLYPHASE CURRENTS.

A two-phase generator consists of two single phase windings in quadrature (*i. e.*, with coils bisecting or connected at right angles). Each phase may be entirely separate from the other

[1]Paper read before San Francisco No. 1, N. A. S. E., August 26, 1909.

though they are more commonly interconnected at a neutral point.

Currents delivered by a two phase generator exert four impulses per cycle as against two impulses from the single phase machine. Obviously, there are no dead centers and a two-phase motor must on this account exert more continuous torque than a single phase motor.

Three phase generators have three sets of windings, or coils. These may be grouped and connected in delta or star, the output so far as phase and frequency are concerned, being the same in either case, *i. e.* there are six impulses per cycle as against two from the single phase machine.

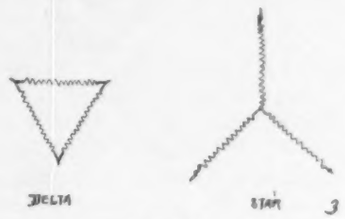


Fig. 3.

There is a very slight advantage in three phase motors over two phase motors and a very great advantage over single phase motors. This is due to the more nearly continuous torque or turning effort exerted during each cycle.

Summarizing: Single phase currents have two *dead* points per cycle. Two phase currents have no dead points and a high mean torque. Three phase currents have no dead points and a slightly higher mean torque than two-phase currents. In connecting three phase generator windings a great difference may be obtained by connecting in different ways.

In delta grouping each set of coils must be proportioned to generate full line voltage whereas if star connected, the voltage across each group of coils is only 57.7 per cent of the line voltage, or conversely the line voltage is $\sqrt{3}$ times, *i. e.* 1.73 times that of each group or phase. (Fig. 3).

Another very important feature of the number of phases of an A. C. circuit is the current, *i. e.* amperes, requisite for a given power delivery. Considering a load of unity power factor and uniform voltage, say 200 volts: With single phase, the watts delivered will be the product of volts times amperes, or 200 volts times 300 amperes equals 60,000 watts or 60 k. w. Conversely 60,000 watts divided by 200 volts equals 300 amp.

With two phase the same power would be delivered with 150 amperes per phase, the load, in such case, being divided into two single phase circuits, each of half the capacity of the single

Fig. 4.

phase circuit.

With a two phase four wire circuit there will be no saving in copper over the single phase. The two phases may, however, be interconnected (Fig. 4) *i. e.*, one side of each phase may be combined, thus making a two phase three wire circuit. In this case the center wire, *i. e.* the one carrying part of each phase, must be approximately 1.42 times the size of either of the others, the current being two times that of either phase alone. This is commonly done on transformer secondaries, but cannot be done when the circuit is connected to the generator unless the generator is of the open coil type, *i. e.* phases not interconnected in

the generator. If the generator *is* of the interconnected type, the three wire connections would constitute a short circuit of the generator windings.

Where three wire two phase circuits *can* be used it permits a saving in copper of approximately one-fourth of one phase or, to be more exact, about 14 per cent of the total copper required for two phase four wire.

Imagine the single phase circuit divided into three single phase circuits, each of 20 k. w. capacity, or total of 60 k. w. as in the first case. Now connect these three circuits as one three phase circuit by combining one side of each with the next as in Fig. 1. The current will not be 100 amperes per phase, or one-third of that, in the first case, for the reason that the flow of current in each phase is 120 degrees behind the other and each wire, therefore, carries not only its own relative current per phase but also part of the succeeding phase, at any instant. The total current per wire will be 3 times the current of one single phase circuit of one-third the total capacity, that is, 1-3 of 300 amperes or 100 amperes times $1/\sqrt{3}$ or 1.73=173+amperes.

Now connect one side of each of these single phase circuits to a common central or return wire, thus forming what is known as star connection. Voltage conditions now change. With the same impressed voltage per coil or group of coils, *i. e.* 200 volts, the voltage between wires will be (*i. e.* 1.73) $1/\sqrt{3}$ times 200 or 346 volts, or conversely with the same line voltage, *i. e.* 200 volts, the voltage per coil or group of coils will be 200 divided by $\sqrt{3}$ or 116 volts. It will, therefore, be seen that for a given voltage a generator connected three phase star will require a less number of turns per coil or per phase and will, therefore, be slightly cheaper to build.

Three phase transmission permits a much greater saving in copper than one or two phase, the actual saving being one wire as compared with two phase or one-half of one wire as compared with single phase or 25%.

Other important factors, which have not been considered in the above, are reactance and self induction, (which depend largely upon the arrangement of the circuit) and *power factor.*

The last mentioned, *i. e.* power factor, is of very great importance in the design of generator, motor and line; it represents the difference between the *actual* and the *apparent* power delivered. At unity, *i. e.* 100% power factor the current and e. m. f. are in phase; as the current lags behind the e. m. f. the power factor decreases.

This means that the current, *i. e.* amperes, increase in proportion to power delivered. It is the quantity of current, *i. e.* amperes, that heats the conductors and determines their carrying capacity. for example: deliver 300 amperes say over a 0000 wire. Now at 100% power factor we can deliver 60 k. w. with 200 volts, say 100 ft. with a given drop—with a single phase and neglecting impedance say of 1½% or 3 volts. Now at 80% power factor our apparent k. w. would be 60 divided by .8 equals 75 k. w. which at 200 volts would mean 375 amp. or at 50% power factor 60 divided by .5 equals 120 k. w. which at 200 volts would mean 600 amperes or twice the current at 100% power factor; or two 0000 circuits in place of one to deliver the same load.

This same line of reasoning applies to the generator, transformers and line, so that too much stress cannot be laid on keeping up your power factor.

No induction motor can be made to work at 100% power factor. This is because this type of motor must depend on the currents in the armature or primary windings for its magnetization, this current being out of phase with (at a right angle) to the current doing the work. The best commercial types of induction motor range from 85% to 96% power factor when operated under full load. As the load decreases the power factor decreases, so that you can see the importance of keeping your motors *fully loaded.* Synchronous motors (*i. e.* motors with their fields separately excited) are frequently used to counterbalance this effect on transmission circuits, their fields being overexcited, thus creating a leading power factor or idle current in the line, thus bringing the entire circuit up to 100% power factor.

Induction motors are inherently a constant speed type, though they are used very extensively and very satisfactorily for variable speed work. Assume a current flowing through a primary coil of a motor at a given frequency, say 7200 times per minute; the natural thing for the current excited in the secondary element by this current is to fall into rythmic step with it. This means that the speed must be such (for the most efficient results) as to permit the secondary conductor to pass within the influence of the primary coil at the same frequency—*i. e.* constant speed. Any variation from this periodicity means a certain slip between the two. The greater the slip (*i. e.* speed reduction) the greater must be the losses. The most practical way to attain this slip is by putting resistance in the secondary circuit. Speed reduction can be obtained by putting resistance in the primary (and by several other methods) thus reducing the voltage applied to the motor but this is not extensively used.

The types of variable speed induction motors have been used quite successfully. One—known as the variable speed type "C" Westinghouse consisted of a motor with squirrel cage secondary with high resistance end rings on the secondary, the control consisting of auto transformers for varying the voltage on the primary. These motors were designed for crane service. The other type, now almost universally used, for hoist dredge and crane service, consists of motor with windings on the secondary very much like the primary, connected in star with external resistance and a controller for short circuiting this resistance (Fig. 5).

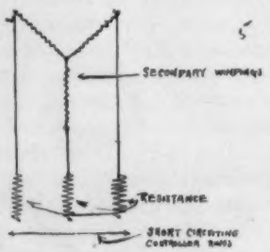


Fig. 5.

These motors are designed to meet several different classes of service. For heavy duty, such as dredge work, they must be designed for continuous operation on any notch of the controller. This means that the windings, both primary and secondary must be proportioned for heavy currents, as low speeds mean low power factor and increased currents with consequent high temperature. The resistance must be able to take care of these heavy currents and dissipate the heat. Manifestly the resistance must be kept away from inflammable substances or there will be trouble.

For hoist work or other intermittent service the motor may be smaller and the capacity of resistance less, for the reason that there is generally a considerable period during which current is not applied and the whole equipment can cool off. The earlier design of variable speed motor was quite noisy, especially when operating at less than full speed. This was apparently due to vibration of the secondary windings caused by the reversal of the current, *i. e.* alternations. This has been remedied, in fact almost entirely overcome, by skewing or twisting the secondary slots and winding so that one end of the coil enters the field ahead of the other, that is, diagonally.

Methods of starting and controlling the speed of induction motors varies with the service to be performed. Constant speed motors of small size are started by connecting directly to the circuit by means of a switch. Larger sizes are started by the resistance method (*i. e.* putting resistance in the primary circuit) and the auto starter method—except in some special applications where a large starting torque is required, in which

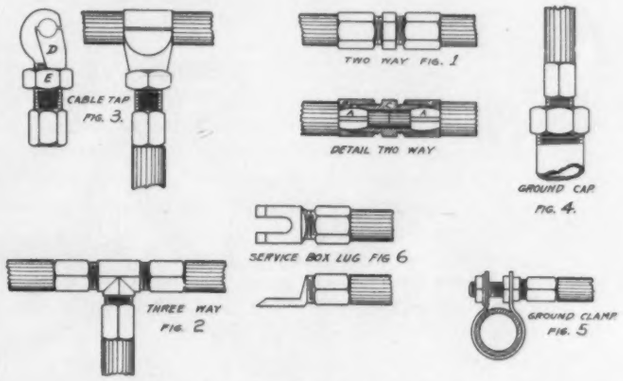
(continued on page 222)

INDUSTRIAL

MECHANICAL CONNECTORS.

The increasing use of mechanical wire connectors in many classes of wiring, particularly by the electric illuminating companies, has led to a steady development and improvement in these devices. A short description of the method followed by the Edison Illuminating Company of Brooklyn in wiring up transformers is appended. Mechanical connectors are used exclusively from the tap-off at the pole line feeder cable to the service cut-out boxes in the building served, soldering processes being entirely eliminated.

Sketch 1 shows the different types of connectors used. The mechanical detail of the joint is shown in Fig. 1. The part that grips the wire is the bushing or sleeve A. It is a piece of tubing slotted longitudinally and tapered at both ends. One end of this sleeve fits into the tapered part of the nipple C, while the other end fits into the tapered part of the nut B. When the nut is screwed up on the nipple the action of the taper causes the sleeve to decrease in diameter and grip



Sketch of Connectors Used (No. 1).

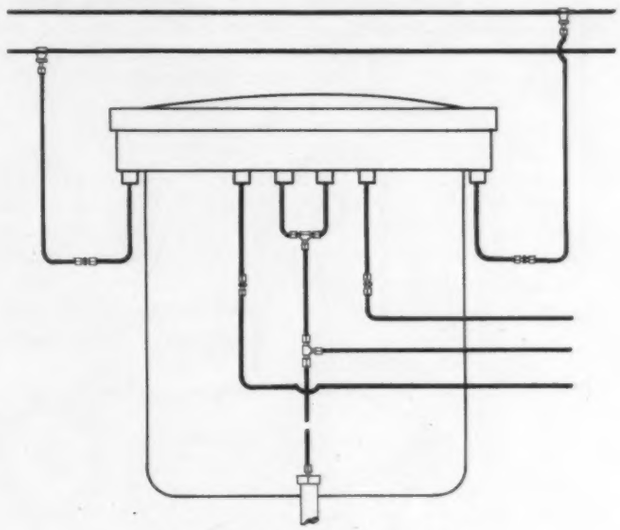
the wire. A joint made in this manner will hold up under an exceedingly large tensile strain and will not heat.

The company in question supplies power to transformers through single phase lines and uses 3-wire secondaries. The connectors used in installing a transformer are the 2-way (Fig. 1), 3-way Fig. 2), cable tap Fig. 3), and grounding cap (Fig. 4).

The primary leads are connected to the mains by use of the cable tap. This connection is made so that it is not necessary to cut the mains in order to take off a lead. By screwing the jam nut E down on the shank of the connector the cover D can be removed. To make this connection the hook, with cover taken off, is placed over the bare wire. The cover is then put in place and tight contact obtained by screwing up the jam nut. The shank of this tap is supplied with a compression nut and sleeve as previously described by means of which the lead is fastened to the connector. The primary transformer leads are connected to the leads from the fuse boxes by means of a 2-way connector.

In connecting to the secondary two of the service wires are connected to the two outside secondary leads by means of 2-way connectors. The two middle secondary leads are then connected together by means of a 3-way joint. From the remaining branch in this 3-way a lead is taken which runs into another 3-way joint, from the two remaining branches of which the middle secondary and ground wire are taken. The ground wire is connected to the earth as follows: A galvanized iron pipe 14 feet long is driven into the ground for a distance of 7 feet while the part remaining above ground is stapled to the pole and covered with a wooden guard. To the top of this pipe a grounding cap is screwed to which the ground wire is connected by means of a mechanical sleeve. When the ground wire is to be connected to a pipe already installed the ground clamp (Fig. 5) is used. The service wires are connected to the building circuits through a porcelain service cut-out box. The wires are connected to the two sides of this cut-out by means of the mechanical lug shown in Fig 6.

This complete the connections so far as the company is concerned and the only tools necessary are a wrench and an instrument for stripping the insulation from the ends of the wires. The wiring can be disconnected at any time in a few



Sketch of Connections (No. 2).

minutes with the aid of a wrench, leaving the ends of the wires in perfect condition. Such connections can be made in all kinds of weather without the least difficulty. All the connectors used by the company are universal i. e., they will take any size of wire from one predetermined to the smallest size used. This is accomplished by having the nipples and nuts of the connectors made all the same size and using sleeves or bushings with the same outside diameter so that they will fit into the connectors but with the inside diameter or wire hole made to fit the different sized wires in question.

Many advantages are claimed for this system, the principal ones being that it makes better joints and costs less. The connectors used are known as Dossert joints.

RECENT ALLIS-CHALMERS SALES.

Recent sales of Allis-Chalmers electrical apparatus, exclusive of combined generating units, which constitutes a large list in themselves, include the following:

Merchants Heat & Light Co., Indianapolis, Ind., two 1000 k. w. synchronous motor generator sets, 3 phase, 2300 volts, 60 cycle, a. c., 250 volts shunt wound d. c., and one 200 k. w. shunt wound balancing set, consisting of two 125 volt machines on a common cast iron base. Delaware, Lackawana & Western Railroad, Hampton Power Plant, Scranton, Pa., one 1500 kva., O. F. W. C., 3 phase, 60 cycle transformers, 4150-2200 volts. San Francisco Gas & Electric Company, San Francisco, Cal., two 1000 k. w. synchronous motor-generator sets,

3 phase, 11,000 volts, 60 cycles, a. c., 275 volts compound wound d. c. Great Northern Railway Co., St. Paul, Minn., 9 induction motors, aggregating 220 h. p., 440 volts, 3 phase, 60 cycles; Joseph Light and Power Co., Joseph, Ore., one 225 k. w. a. c. waterwheel type generator, 2300 volts, 2 phase, 60 cycles, with exiter and switchboard. Portland Railway, Light & Power Co., Portland., Or., one 500 k. w. vertical direct current generator, 600 volts, with switchboard. Wind River Lumber Co., Cascade Locks, Ore., one 100 h. p. induction motor, 3 phase, 60 cycle, 440 volts. Caldwell Milling & Elevator Co., Caldwell, Idaho, one 100 h. p., 220 volt, 3 phase, 60 cycle induction motor. Pocahontas Consolidated Collieries Company, Switchback, W. Va., one 175 h. p. 2080 volt, 3 phase, 60 cycle induction motor. Toledo & Indiana Railway Co., Toledo, Ohio, one 400 k. w. rotary converter, 500 r. p. m., 25 cycle, 3 phase, 600 volts d. c., with three 150 kva., O. F. S. C. transformers 3200/375 volts, together with switchboard. Victor Talking Machine Company, Camden, N. J., eight type "K" motors, aggregating 530 h. p., 220 volts d. c. Goodyear Lumber Company, Tomah, Wis., nineteen induction motors aggregating 925 h. p. Crane Company, Chicago, Ill., one 300 k. w. synchronous motor-generator set, 440 volts, 60 cycle, a. c. 250 volts d. c. and three 100 h. p. induction motors, 440 volts, 60 cycles. Great Western Power Co., San Francisco, Cal., fifteen O. F. S. C. transformers, 22,000/2400 volts, aggregating 2100 kva. Milwaukee & Fox River Valley Railway Co., one 200 k. w., 2300 volt synchronous motor, 60 cycles. Diamond Match Co., Barberton, C., 11 induction motors, aggregating 75 h. p. Illinois Steel Co., Joliet, Ill., one 1250 kva. synchronous frequency changer, changing from 3 phase, 2200 volts, 60 cycle, to 3 phase, 6600 volts, 25 cycles, 300 r. p. m.; one 200 k. w. synchronous motor generator set, 3 phase, 25 cycle 6600 volts, 2200 volts d. c., together with switchboard. Cambria Steel Co., Johnstown, Pa., one 500 k. w. rotary converter, 3 phase, 25 cycle, 575 volts d. c. Pacific Lumber Co., Wilmington, Cal., seventeen induction motors, aggregating 510 h. p. Royal Weaving Co., Pawtucket, Rhode Island, thirteen O. F. S. C. transformers, aggregating 1200 kva., 2200/220 volts. City of Ellensburg, Wash., one 550 k. w. water wheel type alternator, 3 phase, 60 cycle, 6600 volts, together with switchboard, exciter, and three 200 kva. O. F. S. C., 6600 volts transformers. National Casket Co.,, Pittsburg, Pa., twenty-four induction motors, 440 volts, 3 phase, 60 cycle, aggregating 275 h. p. Frankling Power Co., Farmington, Maine, two 200 k. w. 600 r. p. m., 2300 volts, 3 phase, 60 cycle alternators, together with exciters and switchboard equipment. Lowland Worsted Co., Woonsocket, R. I., thirty-one induction motors, 350 volts, 3 phase, 60 cycles, aggregating 350 h. p., together with textile switches. Daniel D. Weschler & Sons, Ind., Milwaukee, Wis., one 300 k. w., 200 r. p. m., 240 volt, 3 phase engine type alternator, one 150 k. w. 200 r. p. m., 240 volts, 3 phase engine type alternator, together with exciters and six induction motors aggregating 200 h. p. Chicopee Manufacturing Co., Chicopee Falls, Mass., 68 type AN. induction motors, aggregating 484 h. p. Everett-Metzger Flanders Co., Detroit, Mich., four 100 kva. O. F. S. C. transformers, 4300 volts primary, 115 volts secondary, with switchboard. Apache Cotton Oil and Manufacturing Co., Chickasha, Okla., three type AN. induction motors, aggregating 350 h. p. Pine Creek Manufacturing Co., Camden, S. C., one 150 k. w., 133 r. p. m., 600 volts, 40 cycle engine type alternator, together with exciter and switchboard equipment. Kansas Elevator Co., Atchison, Kans., eleven Type AB. induction motors. Edison Electric Co., Los Angeles, Cal., six 400 k. w. O. F. W. C. transformers, 50 cycle 17,000, 2200 volts. Light, Heat & Power Corporation, Clinton, Mass., one 250 k. w. belted alternator, 3 phase, 2300 volts, 60 cycle. North Adams Gas Light Co., North Adams, Mass., one 11 panel switchboard. Oak Park Power Co., Flint, Mich., three 75 k. w. O. F. S. C. 2300 volt primer 136 volts secondary, transformers

ON THE GENERATION AND APPLICATION OF ALTERNATING CURRENTS.

(Continued from page 220.)

type, with wound secondaries and separate resistance in the secondaries, is used.

The auto starter, which is essentially a Westinghouse device, gives the best results obtainable for ordinary constant speed work. This consists of two transformer coils connected between the line and the primary of the motor, enclosed in a cast iron case, with a switch arranged to cut out the successive sections of the transformer coils. At the start the coils are connected so as to apply from 50 to 70% of full line voltage to the motor terminals; as the coils are cut out the voltage is gradually increased until full line voltage has been applied, the auto starter coils then being out of circuit. As all induction motors take large starting currents, and these currents are dependent on the impressed voltage, the advantage of the auto transformer over resistance in primary method is apparent. For example, consider a motor requiring 200 amperes starting current at 50% line voltage. With the auto starter, the current drawn from the line would not exceed 130 to 135 amperes. With resistance to reduce voltage on motor terminals to 50% of line voltage (so that the current drawn by the motor would still be within the 200 ampere limit) there would nevertheless be 200 amperes drawn from the line. In other words with a transformer, a local circuit is established, whose amperage may greatly exceed the line capacity, though at lower voltage, whereas with resistance we must depend directly on the circuit for all the current, *i. e.* amperes.

In controlling variable speed induction motors it must be remembered that they are comparable to direct current motors controlled by resistance in the armature circuit; consequently unstable. With resistance in the primary or secondary, the results will be the same, *i. e.*, any variation in load will result in a corresponding variation in speed.

This statement does not include motors of the multispeed type, *i. e. motors* wherein speed changes are obtained by changing the number of poles in the primary. From the foregoing it will be seen that the variable speed induction motor is not adapted to such work as machine tool drive or any service requiring great refinements of speed control.

VOLTAGES.

With regard to voltage of apparatus and power systems available:

In small sizes, say 50 h. p. and under, the standard voltages of motors range from 100/110 to 200/220 and 400/440; of larger sizes from 1100 to 2000/2300; though we also furnish 30 and 40 h. p. motors in 2300. Single phase motors are supplied in 100/110 to 200/220 volts only. Generator voltages are apparently being changed to standards of 240-480-600-1200-2400 and 6600 volts, as there seems to be a general tendency toward higher working pressures; 220-440-1100-2200 and 6600 have heretofore been the standards.

Power distributing systems conform very closely to the above, though 6600 volt primary distributing circuits are becoming very common, this voltage effecting a considerable saving in copper as compared with the older 2200 volt service. Transformers are usually required and 6600 volt primary appears to be about as easily handled as 2200.

TRADE NOTES.

The National Wood Pipe Company of Portland has just secured a contract to build a pipe line 8 feet in diameter, 1700 feet long for Ential L. and P. Co., of Wenatchee, Wash.

Austin McCain Company, electrical engineers, have moved from 308 Post street, to new and larger quarters at 214 Wall street, Spokane. They have several carloads of motors, etc., on the way from the east.

NEWS NOTES

FINANCIAL.

LA GRANDE, ORE.—The special election for the issuance of bonds for a municpal light plant carried.

UNION, ORE.—The proposition to issue bonds to the amount of $25,000 for the purpose of establishing a municipal lighting plant passed.

CENTRAL POINT, ORE.—S. A. Keen & Co. were the successful bidders for the city water bonds. The work of constructing the water system for this city will soon be commenced.

JACKSONVILLE, ORE.—By a vote of the people it has been decided to issue bonds to the amount of $25,000 for the purpose of constructing and maintaining a system of waterworks for the city of Jacksonville.

INCORPORATIONS.

SAN FRANCISMO, CAL.—Pacific Pyro One-Light Electric Sign Company, capital stock $10,000, by J. C. Kind, T. J. Flynn and John McMullan.

SAN JOSE, CAL.—Pacific Coast Oil Company, incorporated by C. W. Felton, L. D. Fisk, George Loomis, George Hedges, and James Lawler.

SANTA FE, NEW MEX.—Cimarron Water Company, capital stock $100,000 subscribed by Charles Springer, Frederick Whitney, and George E. Remley.

BAKERSFIELD, CAL.—Positive Oil Company, capital stock $200,000, subscribed $10,000, by L. H. Byron, C. C. Friend, B. H. Hancock, G. Merz and G. L. Warnken, $200 each.

FRESNO, CAL.—Coalinga Crown Oil Co., capital stock $250,000, subscribed $10,500, by S. Mitchell, L. E. Carter, R. A. Van Loan, R. L. Berry, M. A. Lindsay, A. M. Drew, J. C. Pottle, A. M. Gilstrap and E. A. Perkins.

SPOKANE, WASH.—Walla Walla & Western Railway Company, $3,000,000, by E. M. Symonds, M. S. Parker, G. S. Haynes, A. H. Hoffman, E. C. Maxon of Spokane, M. R. Hanger of Dayton and W. L. Russell of Walla Walla.

SANTA BARBARA, CAL.—Merchants' Mutual Light & Power Co., capital stock $1,000,000, subscribed by C. H. Frink, W. R. H. Weldon and John F. Diehl of Santa Barbara; S. M. Kennedy of Alhambra, R. H. Ballard, William Dieterle and Herbert F. Keenan of Los Angeles; L. J. Lee and H. J. Bauer of Pasadena. Principal place of business, Santa Barbara.

MILES CITY, MONT.—Articles of incorporation of the Buffalo Rapids Power Company has been filed. The capital stock is $300,000, of wihch George Burt owns 2998 shares, Della M. Burt one share and H. E. Fearnall one share. The object of the company is to take a ditch out of the Yellowstone River, secure the amount of fall necessary and build an electric generating plant from which to supply light and power to cities along the Yellowstone from Billings to Glondivo. The dam in the Yellowstone will cost about $25,000.

TRANSMISSION.

BAKER CITY, ORE.—A franchise has been granted to the Eagle River Power Company to erect pole lines on streets and alleys of the city.

OSWEGO, ORE.—The Oregon Iron & Steel Company is planning to install a power plant at the lower end of Tualatin lake, near the company's large dam above Oswego.

POTLATCH, ORE.—The Potlatch Lumber Company is putting in a new 600 k. w. power plant, including Westinghouse steam turbine and generators. Nixon & Kimmel of Spokane are installing engineers.

NEWPORT, WASH.—The Fidelity Lumber Company of Newport is putting in a 550 horsepower Corliss engine and belted motors. Nixon & Kimmel of Spokane are the installing engineers.

PORTLAND, ORE.—A power plant, capable of furnishing light and power for factories, private enterprises and the towns surrounding Oswego, is projected by the Oregon Iron & Steel Company at Oswego.

WALLA WALLA, WASH.—The Washington State Prison is building a new jute mill of 600 horsepower. The building will be 173x300 and is to be operated by electric power from the Northwest Gas & Electric Company.

BUTTE, MONT.—The Amalgamated Copper Company is putting in a hydro-electric plant to generate 50,000 h. p. at Great Falls, Montana. They are now constructing steel tower transmission lines to Butte and Anaconda.

ODEGON CITY, ORE.—Glen Hurst of Aurora, Ore., has charge of construction of the plant to be built by the Molalla Power Company at at cost of $10,000. It will be erected at Canby, and be ready for operation in October.

SAN DIEGO, CAL.—Contracts have been let by the Edwards Wave Motor Company to the National Iron Works of this city for machinery, including six power producing units. It is probable that the plant will be built at La Jolla.

EUGENE, ORE.—Sealed proposals are being received for the construction of a fifteen miles transmission line from the city's hydro-electric plant on the McKenzie river. Separate bids will be received for placing insulators and stringing the line.

JOSEPH, ORE.—The Joseph Light & Power Company is putting in a 400 h. p. hydro-electric plant; 100 ft. head. The Allis-Chalmers Company's office at Spokane is furnishing full equipment, including wheel, 225 k. w. d. c. generator, transformers and switchboard.

ASTORIA, ORE.—The Hammond Lumber Company is about to erect upon its own territory at the Tonguo, an electric plant which is to serve its own great plant for lighting, heating and power purposes, at a cost of $75,000 or $80,000. From this source, the energy contracted for by the Astoria Electric Company is also to be derived.

NEWPORT, WASH.—The Northern Idaho & Montana Power Company, Sandpoint, Idaho, one of H. M. Byllesby & Company's western sub-companies, are completing a 30-mile wood-pole transmission line from Lared Point, Idaho, to Newport, Washington, 3 phase, 3 section insulator, 66,000 volts. They have also installed step-up transformers at Sand Point.

WALLA WALLA, WASH.—The Washington Traction Company, recently organized, capitalized for $3,000,000; bonds sold in London. Gilbert Hunt, Walla Walla, president; W. H. Richardson, Dayton, vice president; J. B. Catron, treasurer; Ben C. Holt, secretary; J. C. Armstrong, general manager; S. N. Raymond, Philadelphia, consulting engineer. Overhead standard gauge trolley line will be erected from Dayton to Pasco via Wartsburg, Walla Walla, Touchet, Walula and Kennewick. Hydro-electric plant on Tucanon river, 15 miles from Dayton, 8000 horse power. Work on grading and dam begins October 1st.

CONCONULLY, WASH.—C. E. Blackwell & Company of Riverside, Wash., Okanogan County, have applied to the county commissioners for a franchise to construct and operate a water system in the town of Riverside.

BEND, ORE.—A. M. Drake of Bend is putting in a hydro-electric plant of 1000 h. p. on the upper Deschutes river. He is now constructing the dam and spillway. The plant is expected to be completed by the first of next year.

FRESNO, CAL.—H. J. Darling of Reno, has appropriated the water flowing in Big Creek in the Sierra national forest reserve in Fresno County to the extent of 40,000 miners' inches for power to be used at or near the junction of the creek named and Pittman Creek and to be thence returned to the natural channel. Also by the same appropriator 20,000 inches of the waters of Pittman Creek.

CHICO, CAL.—William Durbrow of Berkeley, a civil engineer of the Pacific Gas & Electric Company, and three assistants, are at Mill City, in Tehama County, to examine the country and locate feasible sites for new plants. Mr. Durbrow was formerly manager of the Oro Water, Light & Power Company of Oroville, but is now connected with the main office of the company in San Francisco.

KALISPHEL, MONT.—At Kalispehl, the Flat Head Water Power Company, a Byllesby Company organization, are enlarging dam and ditches at Big Fork and contemplate adding two 1,000 k. w. generators. The company is also putting in a $100,000 telephone system with long distance service at Kalispehl, and installing a 300 k. w. steam generating plant at Polson, a new town on the Flat Head Reservation.

METHOW, WASH.—Work has been started by the Methow Irrigation, Power & Traction Company on its power plant on the north fork of the Methow river, six miles above Winthrop. The entire volume of the River will be utilized, with a 140-foot fall, in the generation of electric power. Contracts have been closed for the use of 800-horsepower for pumping water to irrigate high bench lands in the upper end of the Methow valley.

SPOKANE, WASH.—The Washington Water Power Company's new sub-station at Spokane Falls, of 30,000 k. w. will ultimately be divided into equal parts of 10,000 k. w. each, for Edison system, railway system and alternating distribution from center of town. They are also installing hydro-electric gas plant at Little Falls to develope 30,000 h. p. The first unit of this plant will be complete by next June. The first water wheel for the plant was received from I. P. Morris Company, was delivered last week. This plant will be in four units of 5000 kilowatts each, connected with four wheels 9000 h. p. each. A steel tower line will connect this plant with the Twenty-ninth Street sub-station in Spokane. The above sub-station is being enlarged, several new transformers being added. The company still continues the work of putting transmission lines underground in the business sections.

SAN FRANCISCO, CAL.—Water rights and land belonging to the Sierra Nevada Water & Power Company, one of the enterprises of the insolvent Market Street Bank, have been attached by the Sheriff of Calaveras county to satisfy a judgment recently secured against the corporation by Milton Bernard, assignee of a number of creditors. The judgment, which is in the sum of $10,562.51 represents in part claims made for labor, services and material, the chief claimant of this character being Franz T. Towle whose bill was $1617. A note amounting to $6521.06 forms the basis of the remainder of the judgment. Among the water rights attached are 200 miner's inches in the south fork of the Mokelumne river, 20,000 miner's inches in the middle fork, and 30,000 in the south fork of the same stream; Clark's ditch, running from the south fork to Railroad Flats; and some land along the road leading from Railroad Flats to West Point, Calaveras County.

ILLUMINATION.

SANTA MONICA, CAL.—The City Clerk has been instructed to advertise for bids for posts and lights.

ESCONDIDO, CAL.—Sealed bids will be received up to September 14th for an electric light pole and wire line franchise.

VENICE, CAL.—Sealed bids will be received up to August 30th at Ocean Park for installing electric posts, fixtures and lights on several bridges in the canal district of the Venice of America tract.

PORTLAND, ORE.—The Portland Gas Company is laying high pressure pipe to encircle the city and distribute in the more sparsely settled outlying sections of the city. The line when complete will be more than fifty miles in length.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has paid Walter H. Linforth, an attorney, $13,904.50 in satisfaction of a judgment rendered in the Superior Court October 5, 1905, as compensation for damages caused by a gas explosion in flats belonging to Linforth.

MILES CITY, WASH.—Solway & Johnson have submitted a request to the city council for a franchise for the construction and maintenance of gas works, gas mains and other fixtures necessary to the operation of gas works and the transmission through the streets and alleys of the city for private or public use.

ODESSA, WASH.—The Town Council has granted a franchise to the Washington Water Power Co. for a lighting system. It is estimated that lights can be ready by Christmas. About $500,000 will be spent in constructing the line and in installing the lights and pumping plant. The line will connect with the Harrington-Sprague line about 20 miles east of Odessa.

BOSTON, MASS.—Directors of the Seattle Electric Company have declared a quarterly dividend of 1¾ per cent on the common stock, payable October 15th to stock of record October 1st, placing the stock on a 7 per cent per annum basis, an increase of 1 per cent. They also declared the regular semi-annual dividend of 3 per cent on the preferred, payable October 1st to stock of record September 10th.

TRANSPORTATION.

REDLANDS, CAL.—Construction work will start in October on the Redlands and Yucaipa electrical road. Already more than a mile of line has been built in Redlands.

LOS ANGELES, CAL.—An ordinance has been adopted granting a franchise to the Pacific Electric Railway Company to construct and operate an electric road along a portion of Seventh street, Long Beach.

SAN BERNARDINO, CAL.—At a meeting of the City Council a petition was received from Fred Durham of Redlands for a franchise to extend his electric line from Third street and E north along E to Sixth, west on Sixth to Mt. Vernon and north on Mt. Vernon to the base line.

SPOKANE, WASH.—The Spokane, Walla Walla & Western Traction Company has been organized to build an electric line from Spokane to Walla Walla. Capital stock, $3,000,000. E. M. Symonds, president; M. S. Parker, vice president; L. H. Hoffman, Hutton block, secretary and treasurer. M. S. Parker is chief engineer.

LOS ANGELES, CAL.—The Los Angeles-Pacific system is making an arrangement with the Southern Pacific whereby the eight miles of the latter corporation's track between Los Angeles and Sentous Station will be leased and converted into a trolley line, and the beach electric passenger cars pulled directly into the Arcade station.